



COMPOSITION OF AMERICAN HONEYS

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COMPOSITION OF AMERICAN HONEYS

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Composition of American Honeys

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Service

Each year about 250 million pounds of honey is harvested by the beekeepers of the United States. This honey is produced by more than 5 million colonies of honeybees, owned by beekeepers whose operations range from the single hive of the hobbyist to that of the full-time commercial apiarist who may control many thousands of colonies.

Hundreds of plants are known to be attractive to bees as nectar sources. Many of these, either cultivated or in the wild state, occur in local concentrations large enough to be valuable as sources of surplus honey. Since honey is produced in each of the 50 States of this country, the possibilities for variation in its composition and properties are enormous. Added to the variety of nectar-secreting plants are the effects of beekeeping and farming practices, local climatic and environmental conditions, and soils, any or all of which might affect the composition of honey. It is apparent that honey is potentially an extremely variable commodity. This variability retards the extensive use of honey in many parts of the food industry. The trend appears to be toward standardization of ingredients and toward increasing use of materials of known composition. Honey, a most valuable carbohydrate that carries unique flavoring properties, is a relatively complex material whose composition, either in general or specifically, has been only imperfectly known and reported.

Although hundreds of honey types and blends are known, only 25 or 30 are of commercial significance. These are the bulk honeys of trade—the ones that are available from year to year and that provide most of the commercial beekeeper's income. Little or no information has been available on the variations in composition to be expected among these honeys.

Profound changes have taken place in agricultural practices in this country over the past few decades. These have been reflected in changes in the types of honey produced and also in the increased dependence of American agriculture on the honeybee for pollination of many crops. The last analytical survey of the composition of American honey was that of Browne, published in 1908 (9).¹ Honey samples studied were probably of the 1902 or 1903 crops. The procedures then used for carbohydrate analysis of honey have been employed ever since with only minor improvements (12, 25). Recently, innovations have been made (50, 54), and the resulting analyses are far less empirical than previous ones (55). Differences in results for carbohydrates between old and new methods are sufficiently large

¹ Numbers in parentheses refer to Literature Cited, p. 40.

that it is necessary to re-examine the carbohydrate composition of honey by the newer procedures.

A fuller knowledge of the composition of honey and its variation with floral source, age, production area, and crop year is essential to maintaining or improving its competitive position in the market and in the food industry. It is the objective of this bulletin to provide such information.

Only partial attainment of this objective is within our grasp. Physical limitations have confined our efforts to as complete an analysis as possible of 504 samples of honey and honeydew, representing 2 crop years. These samples originated in 47 States and represent 83 single floral types, 93 blends of known composition, and 4 honeydew types. Certainty regarding floral type(s) of the samples is not absolute by any means; further comment on this appears later. Samples of the more common and important types of honey yield some information on variation due to area of production.

REVIEW OF PREVIOUS WORK

Relatively little attention has been given to the composition of American honey in recent years. About 500 commercial "honey" samples were analyzed late in the 19th century during Wiley's crusade for the Pure Food Laws (59). At that time much of the honey on the market was adulterated with other carbohydrate materials. The analytical methods developed during that time were later used by Browne (9) and his report has remained the standard reference in this field. He analyzed 100 samples of honey and honeydew from 42 floral types representing 21 plant families. In addition to dextrose, levulose, sucrose, and dextrin, the amount of ash, free acidity, and the presence of tannin were also determined.

In 1908, Van Dine and Thompson (45) reported the analysis of 54 samples of Hawaiian honey and honeydew. Using a new procedure for dextrose determination in honey, Lothrop and Holmes in 1931 (22) published values for dextrose and levulose for 33 United States honey samples of 30 floral types. Three years later, Lynn, Milum, and Englis analyzed 25 samples of Illinois honey (25) representing 8 floral types and blends. All these analyses were largely empirical, though the analytical methods used by Lynn et al. and by Lothrop and Holmes resulted in more realistic values than those reported earlier.

Eckert and Allinger later (12) published analyses of 112 samples of California honey and honeydew. These represented 47 floral types and blends. The carbohydrate methods they used were essentially those of Browne, which have appeared in the Official Methods of the Association of Official Agricultural Chemists (1) since 1916. Ellegood and Fisher (14) analyzed four samples of fireweed honey by these methods in 1940.

A critical study of methods of sugar analysis applicable to honey was made in 1952 by White, Ricciuti, and Maher (57). None of five methods generally in use or proposed for honey analysis, including the Official Methods, gave results reflecting the true composition of

the sample. Later White and Maher (54) developed an entirely new procedure for carbohydrate analysis of honey, which they applied to 19 domestic honey samples (55). Using this method they found a new category of honey sugars, the reducing disaccharides; the method also provided more accurate values for dextrose, levulose, and higher sugars than did older methods. This method has been used in analyzing the samples in this report. It has been subjected to collaborative testing (48, 50) and accepted as first action by the Association of Official Agricultural Chemists (28). It has also been used in Canada (3), Chile (7), and South Africa.²

HONEY SAMPLES

PROCUREMENT

Samples of honey for the crop years 1956 and 1957 were solicited personally and by mail from beekeepers and producer organizations. Special emphasis was placed on obtaining samples of known source and history. Where local conditions and practices produced complex blends, these were identified as such and are characterized by location, area of production, and time of harvest. Instructions were given on proper sampling and as much detail as possible was requested regarding area of production, floral type or blend information, and type of processing. While unheated samples were preferred, samples of known heating history were accepted. During the 2-year period, 516 samples of honey and honeydew were obtained, of which 12 were not analyzed for various reasons. The locations from which samples were obtained are shown on the map (fig. 1).

TREATMENT AND STORAGE

Procedures for handling samples on arrival were occasionally modified during the work. Approximately the first 200 samples were handled as follows:

If the sample was liquid³ or only slightly granulated when received, it was mixed and a 2-ounce subsample removed and graded for color. This was then stored at -20° C. (-4° F.) within 1 day of arrival. The remainder of the sample was kept at room temperature (23° – 28° C., 73° – 82° F.) in a dark cabinet until analysis.

If the sample was partly or completely granulated upon receipt, it was heated with cap tight in a water bath at 60° C. (140° F.) for 30 minutes. If this did not liquefy the sample, the temperature was raised to 65° C. (149° F.) and heating was continued until liquefaction was complete. The sample was cooled, a 2-ounce subsample was graded for color, and stored at -20° C. (-4° F.). The rest of the sample was kept at room temperature as indicated previously.

² ANDERSON, R. H. SOME CHEMICAL AND PHYSICAL PROPERTIES OF SOUTH AFRICAN HONEYS. Thesis, Univ. of Stellenbosch, Stellenbosch, South Africa, 1958.

³ Determined by a honey polariscope (52).

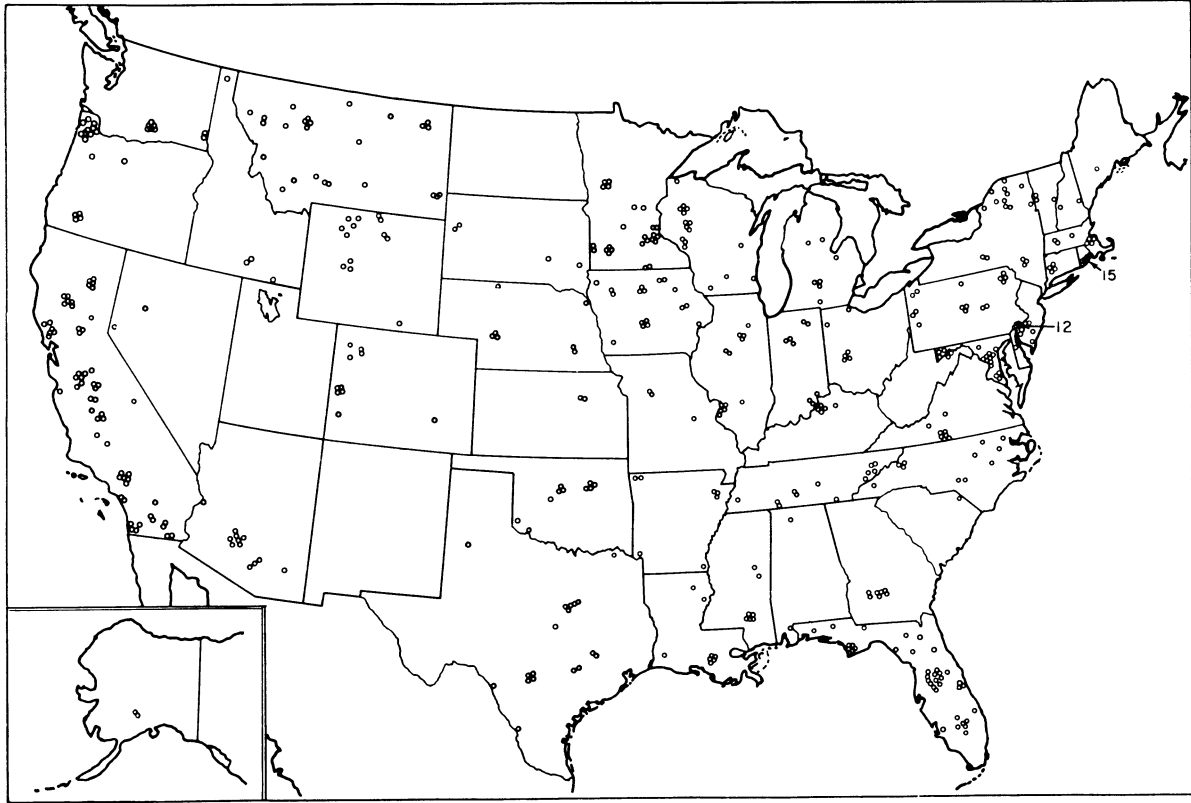


FIGURE 1.—Origin of honey and honeydew samples.

After experience with this procedure it was noted that some unheated samples showed signs of fermentation during storage. These were immediately pasteurized at 60° C. (140° F.) for 30 minutes. The last 300 samples received were therefore handled as follows:

Two-ounce subsamples were removed from producer-unheated liquid samples as before, color graded, and stored at -20° C. (-4° F.). The remainder of the sample was pasteurized as above before storage at room temperature. Liquid samples that had been heated by the producer were not stored in the cold, and the bulk of the sample was pasteurized in the laboratory. Samples requiring liquefaction were handled as before except no subsample was stored at -20° C. (-4° F.).

Some samples were received in the comb. These were crushed in a beaker, warmed to 50° C. (122° F.), and strained through two layers of cheesecloth. They were then treated as described for liquid honey unheated by the producer. Extracted honey samples were strained through two layers of cheesecloth before storage if they contained any extraneous material.

The analytical work on these samples was carried out over a period of about 30 months; therefore, many samples required several heatings to liquefy them so that subsamples would be properly representative. All analyses, except the diastase determination and the storage study (58), were carried out on the samples stored at ordinary temperature. Attempts were made to minimize heat exposure of samples by subsampling for as many determinations as possible at one time.

ANALYTICAL METHODS

Details of all methods used appear in the appendix. This section is limited to the general principles of the various procedures.

Moisture was determined by measuring refractive index on an Abbé refractometer at 20° C. (68° F.) and use of the Chataway table (1).

Color of all samples was determined by the U.S. Department of Agriculture color classifier (8). Each of the six United States color standards for extracted honey (43) was visually split into two zones, light and dark, so that samples were classified into 13 groups ranging from "light Water-White" to "Dark Amber." The classes and their code numbers follow.

Code No.	Color group	Pfund value ¹
		(<i>Millimeters</i>)
0	Light half of Water White-----	Less than 4
1	Dark half of Water White-----	4-8
2	Light half of Extra White-----	8-12
3	Dark half of Extra White-----	12-17
4	Light half of White-----	17-27
5	Dark half of White-----	27-34
6	Light half of Extra Light Amber-----	34-42
7	Dark half of Extra Light Amber-----	42-50
8	Light half of Light Amber-----	50-70
9	Dark half of Light Amber-----	70-85
10	Light half of Amber-----	85-104
11	Dark half of Amber-----	104-114
12	Dark Amber-----	114 and more
13	Blue-----	

¹ The Pfund values for the official grade limits are accurately determined by our procedure; however, the values for the boundaries between the light and dark portions of each class are only approximate.

"Granulation," as recorded in appendix table 27, was estimated empirically as follows: After analysis, the completely liquid sample of honey remained undisturbed for 6 months after its last heating. At this time, its degree of granulation was judged visually and with the polariscope (appendix). It was assigned to 1 of 10 groups, as follows:

Code No.	Degree of granulation
0-----	None.
1-----	Few scattered crystals.
2-----	Layer on bottom $\frac{1}{16}$ to $\frac{1}{8}$ inch.
3-----	Few clumps of crystals.
4-----	Layer on bottom $\frac{1}{4}$ to $\frac{1}{2}$ inch.
5-----	$\frac{1}{4}$ of depth granulated.
6-----	$\frac{1}{2}$ of depth granulated.
7-----	$\frac{3}{4}$ of depth granulated.
8-----	Complete soft granulation.
9-----	Complete hard granulation.

For carbohydrate analysis, the sample was dissolved in dilute alcohol and passed through a column of activated charcoal under controlled conditions. The column was then washed with two solvents of higher alcohol content, with the result that three solutions were obtained from each sample. Dextrose was determined by hypoiodite oxidation and levulose was determined directly, after hypoiodite destruction of dextrose, by a micro copper-reduction method.

On another fraction from the charcoal column, reducing disaccharide sugars were determined directly by the micro copper-reduction method and reported as maltose. In the same fraction, sucrose was determined by increase in reducing power after a mild acid hydrolysis. Where sample identity or high sucrose and higher sugar values (each over 1 percent) indicated its desirability, true sucrose was estimated by invertase hydrolysis, and melezitose was calculated from the difference between apparent "sucrose" and true sucrose.

A third fraction collected from the charcoal column contained all other sugars from the sample, i.e., most trisaccharides and higher sugars. These carbohydrates were hydrolyzed by acid and determined collectively as dextrose by copper reduction.

A portion of each fraction analyzed for all samples was evaporated to dryness and subjected to paper chromatography to monitor the efficiency of the charcoal column separation and to detect any departure from normal of the distribution of the several sugars within each fraction.

The "undetermined" value is the difference between 100 and the total sugars plus the moisture content. Its significance is discussed later.

A study of the accuracy of the selective adsorption method is given in detail in the appendix.

For determination of free acid, lactone, total acidity, and pH, a recently developed procedure was used (56). A honey sample was diluted, its pH noted, and a rapid electrometric titration used to determine free acidity. A back-titration following the addition of an excess of alkali measured lactone content. The total acidity is the sum of these two values.

Diastase was determined on all samples stored at -20°C . (-4°F .) and also on a limited number of other samples. The procedure used was that described by Schade, Marsh, and Eckert (32), as adopted by the Association of Official Agricultural Chemists (28, 50). It has also been used by Duisberg and Gebelein (11). Two advantages over the old modified Gothe procedure are the objectivity of the method and its provision of a continuous scale of diastase activity rather than a limited number of discrete "steps."

For the ash determination, honey samples were slowly dried and charred under infrared heating lamps, then subjected to the usual ashing process. This prevented loss of sample by foaming.

A micro-Kjeldahl method was used for determination of nitrogen.

RESULTS

The results of the analyses are presented in detail in appendix tables 26 and 27, and graphically in figures 2 to 4. The figures show the relative spread of values for all the characteristics listed in appendix table 27. The complete range of values is divided into a number of intervals and the number of samples in each interval is shown. The average values for each characteristic are also indicated on the graphs. Honeydew samples (Nos. 492 to 505) are not included in these distributions.

CHARACTERIZATION OF INDIVIDUAL TYPES OF HONEY AND HONEYDEW

Table 1 shows the average values obtained for the honey samples analyzed, the highest and lowest values found, and the standard deviation for each constituent.

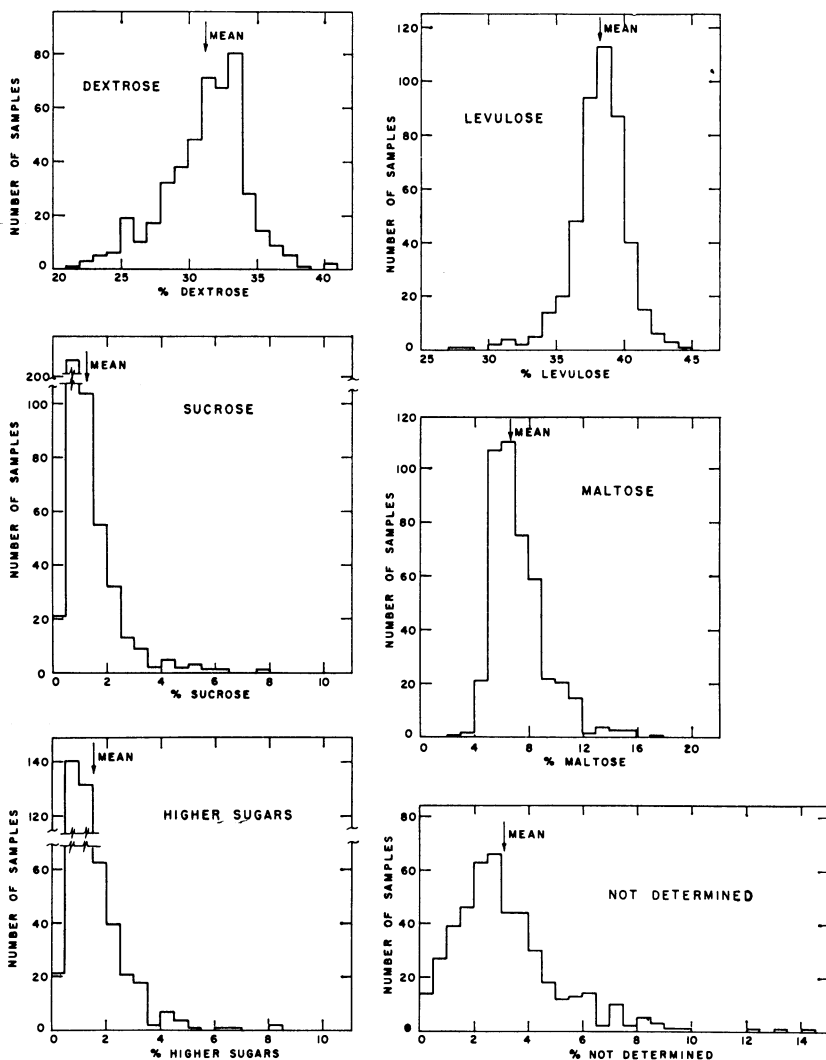


FIGURE 2.—Distribution of carbohydrate values among honey samples.

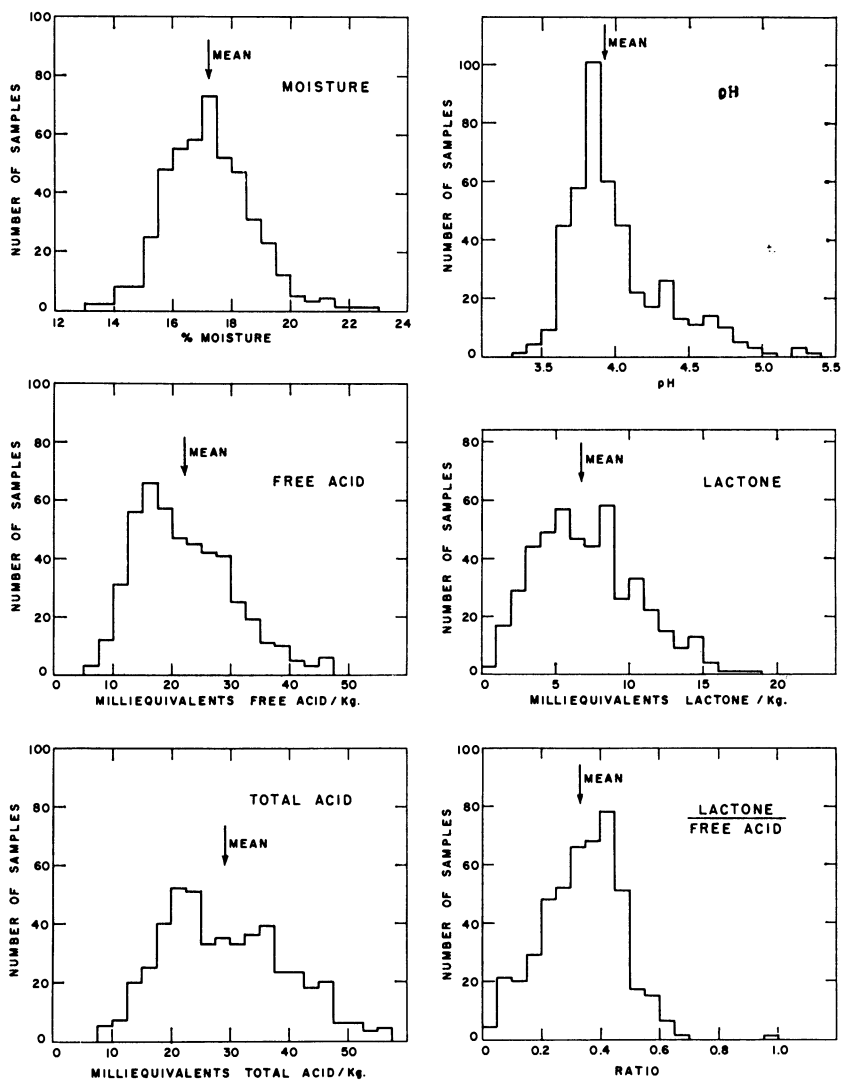


FIGURE 3.—Distribution of moisture, acidity, and pH values among honey samples.

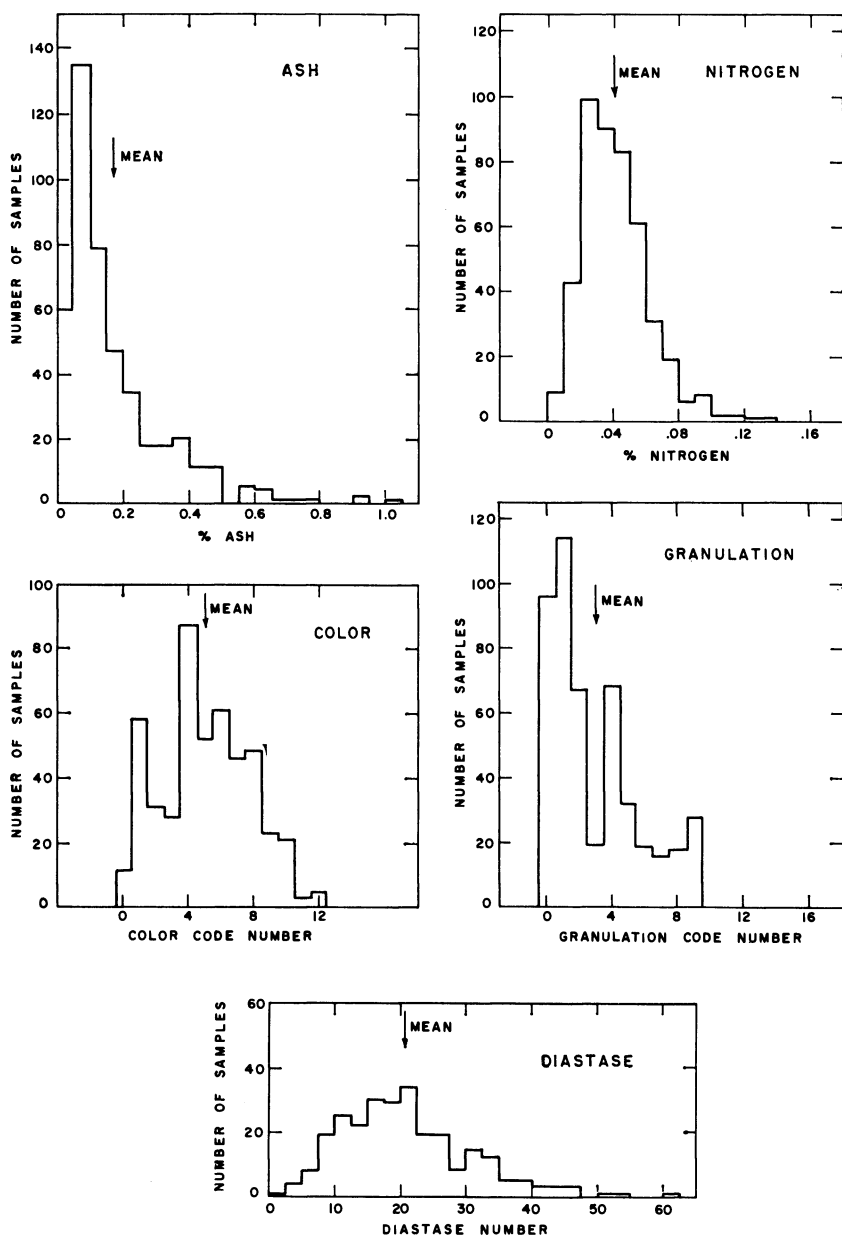


FIGURE 4.—Distribution of ash, nitrogen, and diastase values and of color and granulation tendency among honey samples.

TABLE 1.—Average composition of 490 samples of honey and range of values

Characteristics measured	Average	Standard deviation	Range	
Color ¹ -----	5	2.8	0	-12
Granulation ¹ -----	3	2.8	0	-9
Age-----months-----	12	5.6	1	-33
Composition:				
Moisture-----percent-----	17.2	1.46	13.4	-22.9
Levulose-----do-----	38.19	2.07	27.25	-44.26
Dextrose-----do-----	31.28	3.03	22.03	-40.75
Sucrose-----do-----	1.31	.95	.25	-7.57
Maltose-----do-----	7.31	2.09	2.74	-15.98
Higher sugars-----do-----	1.50	1.03	.13	-8.49
Undetermined-----do-----	3.1	1.97	.0	-13.2
pH-----	3.91	-----	3.42	-6.10
Free acid-----meq./kg-----	22.03	8.22	6.75	-47.19
Lactone-----do-----	7.11	3.52	.00	-18.76
Total acid-----do-----	29.12	10.33	8.68	-59.49
Lactone/free acid-----	.335	.135	.000-	.950
Ash-----percent-----	.169	.15	.020-	1.028
Nitrogen-----do-----	.041	.026	.000-	.133
Diastase value-----	20.8	9.76	2.1	-61.2

¹ See p. 6 for explanation of color and granulation codes.

To facilitate comparisons between various floral types of honey, table 2 shows how 74 floral types and 4 honeydew types compare with these average values. A plus sign in table 3 indicates that the characteristic or constituent is appreciably higher than the average for the type of honey under consideration.⁴ A minus sign indicates that the value is appreciably lower than the average. No mark shows that the honey is about average. An "n" means insufficient data were available for comparison. For example, in general, alfalfa honey granulates more than the average of all honeys analyzed, and is higher in glucose, sucrose, and lactone/free acid ratio. It is lower than the average in higher sugars, undetermined material, ash, and nitrogen. Other values are near the average. Moisture content was intentionally omitted from the table, since we do not believe it is a characteristic of the floral type of honey, but rather depends largely on other factors. No honey was listed minus for granulating tendency unless it was essentially nongranulating in our test. Those marked plus in granulation are particularly prone to granulate. Honeys not marked are average in granulating tendency under the conditions we used—in 6 months' storage after heating, they would deposit thin layers (up to ¼ inch) or clumps of crystals in a jar.

⁴ Statistical tests were not applied to determine significance of these differences.

TABLE 2.—*Characteristics of various types of honey and honeydew*

[+ means higher than average values; — means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diastase
HONEY																
Alfalfa		+		+	+		—	—					+	—	—	
Aster	+	—			—	+			+		—		—	+		n
Athel tree	+	+	+	+			—							+	+	n
Bamboo, Japanese			—			+										n
Basswood														—	—	
Bergamot	+		+								+	+				n
Blackberry	+	—		—		+	+		+				—	+		—
Blueberry	+					+			+							n
Blue Curls		+	—	+					—		+					n
Bluevine			—	—												n
Boneset	+		+	—								+			+	
Buckwheat	+		—		+					+		+				+
Cantaloupe		+		+							+	+			—	—
Cape vine			—				—								—	
Chinquapin	+	—	—	—		+	+	+	+		—		—			
Clover, crimson	—								—					—	—	
Clover, hubam	—			+			—							—	—	n
Clover, sweet yellow	—		+		+					—		—	+	—	—	n
Coralvine	+	—	—	—			+	+	+	+		+		+	+	n
Cotton		+		+		—	—		+					+		
Cranberry	+	—	—	—			+	+	+					+		
Gallberry		—	+						+						—	
Goldenrod				+	—		—		+		—		—			+

TABLE 2.—*Characteristics of various types of honey and honeydew—Con.*

[+ means higher than average values; — means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diatase
HONEY																
Grape.....	+	—	—	—		+						+			+	n
Holly.....	+	—		—		+	+		+							n
Horsemint.....				+			—		—		+	+	+			
Locust.....		—	+	—						—		—		—	—	—
Manzanita.....		+	—	+						—		—			—	n
Marigold.....				+			—		—		+		+	—		+
Mesquite.....		+	+	+			—				—				—	n
Mexican clover.....	+	—								+		+				+
Mint.....	—			+	+			—							—	
Mountain laurel.....	—	—	—	—	—	+	+	+	+	—	—	—	—			+
Mustard.....	+	—		—		+			+					+	+	
Orange.....									—		+		+	—		n
Orange-grapefruit.....					+									—	—	—
Palmetto.....		—				+			+	—		—			—	—
Palmetto, saw.....	+										+	+	+	+	—	—
Pepperbush.....	+		—					+			+			+		—
Peppermint.....	+		+						+				—	+		n
Peppervine.....	+	—	—	—		+									—	—
Poison oak.....		—		—		+	+	+						+	+	n
Privet.....	+						—		—	+	+	+				n
Prune.....	+	+	—	—		+	—		+	—	—	—	—	+	+	n
Raspberry.....	+	—	—	—			+					+		+	+	—
Rhododendron.....	—	—	—	—		+		+	+	—	—	—			—	+

TABLE 2.—*Characteristics of various types of honey and honeydew—Con.*

[+ means higher than average values; — means lower than average; n means insufficient data to permit valid comparison]

Type of honey or honeydew	Color	Granulation	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acidity	Lactone	Total acidity	Lactone/free acid	Ash	Nitrogen	Diastase
HONEY																
Sage.....		—	+	—												n
Snowbrush.....	+									+		+				+
Sourwood.....		—		—		+	+		+		—	—			—	
Spanish needle.....	+	—	+	—							+	+	+	+	+	+
Spearmint.....			+											+		n
Sumac.....	+		—	—			+	+	+	+		+	—	+	+	+
Sunflower.....	+	—						—			+	+			+	—
Thistle, blue.....	—		—							—		—		—		n
Thistle, star.....			—		+		+		—		+	+	+			+
Thyme.....	+								+					+	+	n
Titi.....	+						—		+	—	—	—	—	+	—	
Titi, spring.....	+	—	+	—				+	+	—	—	—	—			n
Trefoil.....	—											—		—	—	—
Tulip tree.....	+	—	—	—		+	+	+	+	+	—	+	—	+	+	
Tupelo.....		—	+	—					—		+		+	—		
HONEYDEW																
Alfalfa.....	+	+	—							+	—	+	—	+	+	n
Cedar.....	+	—	—	—		—	+	+	+	+		+	—	+		n
Hickory.....	+	—	—	—	+		+	+	+	+	—	+	—	+		n
Oak.....	+	—	—	—		+		+	+	+		+	—	+	+	n

NOTE: The following were near average in all above characteristics except diastase, which differs as shown in parentheses: Wild buckwheat, (+); clover, alsike; clover, sweet; clover, white; and crotalaria (—); cucumber, eucalyptus, fireweed, and hearts-ease (n); palmetto, cabbage; and pentstemon (n); purple loosestrife (n); rosinweed (+); vetch and vetch hairy (—).

A plus sign indicates an increase in pH value, which means a decrease in hydrogen ion concentration.

While honey is generally considered to be the sweet exudations of plant nectaries, gathered, modified, and stored in the comb by the honeybee, other sources of carbohydrates are similarly used by the bees. The principal one is honeydew, which includes the secretions of certain insects that feed on plants (aphids, leafhoppers, scale insects). Under certain conditions, honeydew may be gathered and stored in the hive. It may ordinarily be detected in honey by its strong, molasseslike taste.

Among the samples received from producers were several floral blends containing honeydew, so identified in appendix tables 26 and 27. In addition, there were 14 honeydew samples, representing 4 known and 3 unknown types. They are listed as Nos. 492 to 505 in tables 26 and 27, and their average values are given.

Table 3 gives the average composition, standard deviation, and range of these honeydew samples. Table 2 compares the average characteristics of honeydews with floral types of honey. They are distinctly different from the averages for honey. The honeydews are dark in color, usually nongranulating, quite low in dextrose and levulose, high in higher sugars and undetermined material, of high pH value, especially high in free and total acid, and low in lactone/free acid ratio. They are also high in ash content.

Flavors of different floral types of honey are quite characteristic; however, no effort was made in this project to describe flavor. Flavor expression is highly subjective and difficult to communicate. Few people are familiar with more than a very limited range of honey

TABLE 3.—Average composition of 14 samples of honeydew and range of values

Characteristic measured	Average	Standard deviation	Range
Color ¹	10	1. 1	7 -12
Granulation ¹	2	2. 3	0 - 8
Composition:			
Moisture.....percent.....	16. 3	1. 74	12. 2 -18. 2
Levulose.....do.....	31. 80	4. 16	23. 91 -38. 12
Dextrose.....do.....	26. 08	3. 04	19. 23 -31. 86
Sucrose.....do.....	. 80	. 22	. 44 - 1. 14
Maltose.....do.....	8. 80	2. 51	5. 11 -12. 48
Higher sugars.....do.....	4. 70	1. 01	1. 28 -11. 50
Undetermined.....do.....	10. 1	4. 91	2. 7 -22. 4
pH.....	4. 45		3. 90 - 4. 88
Free acid.....meq./kg.....	49. 07	10. 57	30. 29 -66. 02
Lactone.....do.....	5. 80	3. 59	. 36 -14. 09
Total acid.....do.....	54. 88	10. 84	34. 62 -76. 49
Lactone/free acid.....	. 127	. 092	. 007- . 385
Ash.....percent.....	. 736	. 271	. 212- 1. 185
Nitrogen.....do.....	. 100	. 053	. 047- . 223
Diastase ²	31. 9		6. 7 -48. 4

¹ See p. 6 for explanation of color and granulation codes.

² Based on 4 samples only.

flavors, and individuals vary widely in their reactions to flavors. This does not imply that flavor is unimportant; on the contrary, it may be considered the most valuable single characteristic of honey.

IDENTITY OF HONEY SUGARS

In addition to the predominating levulose and dextrose, and the long-known sucrose, honey has recently been shown to contain a number of relatively minor sugars, some rare. The occurrence of maltose, isomaltose, maltulose, turanose, and nigerose was demonstrated by White and Hoban (51). Watanabe and Aso have recently found kojibiose in honey (47). These are all reducing disaccharide sugars and are reported as "maltose" in this work, with the exception of the kojibiose which reacts essentially as a nonreducing disaccharide and therefore is in the "undetermined" category.

When subjected to paper chromatography, the disaccharides of honey give a characteristic pattern of spots (51). All samples analyzed in this project were chromatographed and all showed numerically identical spot patterns.

Considerable variation was seen in the relative intensities of the chromatographic spots among the various samples, particularly of the disaccharide sugars. Samples listed as honeydews or containing honeydew showed a characteristic chromatographic pattern in their higher sugar fraction, including spots or streaks, or both, to the origin of the papergram.

The monosaccharide fractions of all samples analyzed showed only dextrose and levulose. There was considerable relative variation in the amounts of the disaccharide sugars listed, but all samples contained all the sugars as far as could be determined.

ACIDITY OF HONEY

Gluconic acid, which can be formed from dextrose by certain enzymes, has recently been found to be the predominating acid in honey (42). Many other acids have been reported to occur in honey. It has not been established whether the lactone material, which is measured by the titration procedure used in this work, is entirely gluconolactone or if additional lactones are present. The presence of lactone is a general characteristic of honey.

Only two samples (Nos. 336 and 406) contained no measurable lactone. When the variable proportion of lactone in honey was noted (expressed as the ratio of lactone to free acid), it was believed that low values of the ratio indicated the presence of honeydew. The average value of the ratio for all floral honeys is 0.355, and for honeydew is 0.127. The data indicated a possible relationship between the lactone-acid ratio and the pH of the sample. This would be logical, since the equilibrium position of the reaction $\text{gluconic acid} \rightleftharpoons \text{gluconolactone} + \text{H}_2\text{O}$ would be expected to depend on the pH of the medium. The smaller the pH value (greater acidity), the greater the proportion present as lactone, and the higher the lactone/free acid ratio. An analysis of variance for regression of pH on lactone/free acid ratio confirmed this at better than the 1-percent probability level.

Thus, the lower value of the ratio for honeydews (and the two previously mentioned samples 336 and 406, with pH values of 5.01 and 6.10) reflects the generally higher pH values of honeydew.

These higher pH values for honeydew might at first appear to imply a lower acid content. Honeydews, however, have a considerably greater titratable acidity than honey but also a higher ash content. The pH reflects the buffering action of the inorganic cation constituents on the organic acids present, with the pH value depending on the relative amounts of cationic material.

Both anionic and cationic mineral constituents are included in the ash determination reported here. However, an analysis of variance for regression of pH on ash content, and also on total acidity, was calculated using all honey and honeydew samples. A significant relationship (F greater than required for 1-percent probability level) was found between pH and ash, and none was found between pH and total acidity. Thus, the amount of titratable acid does not determine pH, which rather is a result of the natural buffering action of the mineral constituents on the acids.

EFFECT OF CROP YEAR ON COMPOSITION

The last two lines of data in appendix table 27 give the average analysis of all honey samples for the years 1956 and 1957. The 1957 samples are somewhat lighter in average color than the 1956 samples, slightly lower in granulating tendency, slightly higher in levulose, lower in undetermined material, but otherwise the averages for the 2 years are very similar. The two averages are not made up of corresponding samples, however, and their values are dependent on the sample response from producers for the 2 years.

Two other types of comparisons of data can be made to examine the differences in honey between 1956 and 1957. There are seven floral types and blends (totaling 110 samples) in tables 26 and 27 for which samples were numerous enough to allow averaging of data for the individual crop year. The 7 pairs of averages are all of legume honey, 50 samples from 1956 and 60 from 1957. There are also 11 pairs of samples, 1 for each year, for the same floral type, from the same producer and location.

A comparison of the appropriate 1956 and 1957 averages in table 27 indicates that they differ in composition. In nearly all cases, this difference is less than differences among samples of the same crop year and of the same floral type. Several of these sets of data were examined by statistical procedures. For sweet clover-alfalfa honey, for example, granulating tendency of the 1957 samples is significantly less than that of the 1956 samples (1-percent probability level). The dextrose content is significantly lower (5-percent probability level) for the 1957 samples. None of the other constituents differed significantly with the year of production. For the clover samples, granulating tendency was significantly less for the 1957 samples (5-percent probability level). No other significant differences were found.

The second type of comparison of data is that of 22 samples, 1 each year for 11 floral types, from the same producer and location. This type of comparison should reflect differences in the "same" honey

over the 2 years, since the individual samples are comparable for the 2 years. The 110 samples making up the averages described above were not necessarily from the same parts of the country for the 2 years, and the comparisons must be considered as indicative only. The 11 pairs of samples in this second comparison were alfalfa-sweet clover (Nos. 35, 52), aster (62, 63), blend (122, 123), chinquapin (168, 169), white clover (236, 240), coralvine (306, 307), cotton (308, 314), gallberry (329, 332), privet (404, 405), raspberry (412, 413), and vetch (470, 475). The results are shown in table 4. Statistical tests were not used in compiling this table.

Color, granulating tendency, and acidity were most constant. Dextrose showed the most variation, differing in 10 of the 11 pairs; it was higher in 4 and lower in 6. Since granulating tendency varied little, the dextrose changes were relatively small. Higher values were generally found for the 1957 samples for nitrogen, ash, hydrogen ion concentration (lower pH), higher sugars, and moisture content; lower values were found for dextrose, levulose, and color.

TABLE 4—*Comparison of 1957 samples with 1956 samples of the same floral type of honey, each from the same producer and location*

[+ means 1957 was higher than 1956 sample; — means 1957 sample was lower]

Samples compared	Color	Granulation	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
Alfalfa-sweet clover	—		+	+		—	—	+	+		—		—		—		—
Aster			+	—		—					—	+	+	+	+		+
Blend	—		—	—	+	+	—		+						+	+	
Chinquapin		+	+		+	+			—	—	—	+	+	+	+		+
Clover, white	—	—	+		—	—		+			—					—	
Coralvine			+			—											+
Cotton					—		—									+	+
Gallberry	+		+	—	—	+		—	—	—	—	+	+	+	+	+	
Privet	—					+	+	+		—	—	—	—	—		—	
Raspberry				—	—	—	—	—	+	+	+	+	—	+	—	+	+
Vetch		—	—		—	—	+	+	+							+	
Total	5	3	8	5	7	10	6	6	6	4	7	5	6	5	6	7	6

EFFECT OF AREA OF PRODUCTION ON COMPOSITION

The effect of area of production on honey composition is difficult to assess. Only where the floral type has outstanding analytical characteristics can a comparison of samples from different areas provide meaningful information. Even then one cannot decide if differences are due to plant source and climate or simply to the availability of different minor sources.

A few groups of samples were compared from this viewpoint. It is well known that alfalfa honey from the Imperial Valley is darker than alfalfa honey from the Intermountain area and has a more pronounced flavor. Table 5 shows how these two honey types differ in average composition. The Valley values are averages of samples 6, 7, 8, and 10; the Intermountain values are averages of samples 9, 11, 13, 14, 15, 16, 17, and 19.

In addition to the differences in flavor and color, the Valley honey appears to be lower in levulose, higher in dextrose, higher in ash, and considerably greater in free and lactone acidity, though the lactone/acid ratio and pH are not different. It also granulates more readily. However, if the samples are paired and analyzed statistically, most of these differences are not significant, variation among samples of either type being as great as that shown in table 5. The difference in granulating tendency is the only significant factor.

Cotton honey is characteristically rapid-granulating. Examination of averages of samples of cotton honey from three areas provides some information on the effect of location on the composition of a honey type. Table 6 shows averages calculated for two samples from Texas

TABLE 5.—Average composition of alfalfa honey from different areas

Characteristics compared	Intermountain area	Imperial Valley area
Color.....	Light half of Extra White.	Dark half of Extra Light Amber.
Granulating tendency.....	$\frac{1}{4}$ – $\frac{1}{2}$ " layer	Complete
Age at analysis.....months.....	8	16
Composition:		
Moisture.....percent.....	16. 4	15. 8
Levulose.....do.....	39. 55	37. 88
Dextrose.....do.....	33. 28	34. 11
Sucrose.....do.....	2. 42	2. 88
Maltose.....do.....	5. 85	5. 85
Higher sugars.....do.....	. 80	. 83
Unanalyzed.....do.....	1. 7	2. 6
pH.....	3. 83	3. 84
Free acid.....meq./kg.....	15. 18	22. 55
Lactone.....do.....	6. 42	9. 98
Total acidity.....do.....	21. 60	32. 53
Lactone/free acid.....	. 423	. 442
Ash.....percent.....	. 059	. 158
Nitrogen.....do.....	. 026	. 032

TABLE 6.—*Average composition of cotton honey from different areas*

Characteristics compared	Texas	Arizona	California
Color-----	Dark half of White.	Dark half of White.	Light half of White.
Granulating tendency-----	Complete soft.	Complete soft.	Complete soft.
Age at analysis-----months--	9	7	15
Composition:			
Moisture-----percent--	15. 6	16. 3	16. 1
Levulose-----do-----	39. 42	39. 08	39. 77
Dextrose-----do-----	37. 21	37. 35	36. 18
Sucrose-----do-----	. 80	1. 17	1. 52
Maltose-----do-----	5. 02	4. 55	4. 85
Higher sugars-----do-----	. 42	. 57	. 46
Undetermined-----do-----	1. 5	1. 2	. 9
pH-----	4. 42	4. 39	4. 12
Free acidity-----meq./kg.--	26. 23	23. 07	25. 29
Lactone-----do-----	5. 08	3. 85	7. 09
Total acidity-----do-----	31. 31	26. 92	32. 38
Lactone/free acid-----	. 194	. 166	. 280
Ash-----percent--	. 339	. 406	. 258
Nitrogen-----do-----	. 047	. 025	. 047

(Nos. 309, 318), four from Arizona (Nos. 308, 310, 313, 314), and three from California (Nos. 311, 312, 316).

These values are remarkably similar. No striking differences in composition are apparent. The California samples are slightly higher in sucrose, definitely of lower pH (higher hydrogen ion concentration), somewhat higher in lactone/free acid ratio, and somewhat lower in ash. The Arizona samples appear lower in nitrogen content, being but half that of the other two. None of these differences is statistically significant. More samples would be needed for differences of this magnitude to be statistically valid.

Another comparison of this type is between three samples of California orange honey (Nos. 377-379) and three samples of Florida orange (orange-grapefruit) honey (Nos. 382, 389, 391). Table 7 shows the data. The values are similar; only those for nitrogen, lactone content, and the lactone/free acid ratio are significantly ($P=0.05$) different. The Florida samples are unusually low in nitrogen, and the California samples unusually high in lactone content.

Pairs of samples of the same floral type from different areas show the variation ordinarily encountered. Examples are samples 76 and 77, basswood-clover from Wisconsin and Minnesota; 168 and 169, chinquapin from Florida and California; 354 and 355, horsemint from areas 50 miles apart in Texas; 415 and 416, rosinweed from Iowa and Montana. Rather wide ranges in composition among samples listed as the same floral source occur in the various groups of legume honeys. In the group of 1957 alfalfa-sweet clover honeys, one of the more homogeneous groups, one sample (No. 51) is not from the Intermountain area, being from Iowa. It shows the highest moisture, lowest levulose, lowest sucrose, lowest maltose, lowest higher sugars, lowest pH value, highest free acidity, highest lactone, total acidity, and lactone/free acid ratio. It is a distinctly different sample, even though labeled as extra-white alfalfa-sweet clover.

TABLE 7.—*Average composition of orange honey from two areas*

Characteristic measured	California	Florida
Color-----	Light half of White.	Dark half of White.
Granulating tendency-----	$\frac{1}{2}$ " layer	$\frac{1}{4}$ of depth
Composition:		
Moisture-----percent--	16. 7	16. 6
Levulose-----do-----	39. 26	38. 70
Dextrose-----do-----	31. 83	31. 82
Sucrose-----do-----	1. 87	2. 00
Maltose-----do-----	6. 50	7. 70
Higher sugars-----do-----	1. 33	1. 51
Undetermined-----do-----	2. 5	1. 3
pH-----	3. 67	3. 89
Free acidity-----meq./kg--	24. 23	21. 27
Lactone-----do-----	13. 12	7. 28
Total acidity-----do-----	37. 35	28. 55
Lactone/free acid-----	. 540	. 352
Ash-----percent-----	. 082	. 067
Nitrogen-----do-----	. 030	. 009

Both the analytical values and the descriptions of some samples in a group appear to differ markedly from others in the group. For example, of the 1956 alfalfa honeys, sample 2 is high in sucrose, lowest in moisture, and markedly low in acidity, compared with the others. Sample 23 is apparently not alfalfa, being much higher in levulose and lower in dextrose than all the others.

Samples 412 and 413 are listed as raspberry, 1956 and 1957, but the 1957 sample, with low levulose, high higher sugars, and very low lactone/free acid ratio seems to contain honeydew.

RELATION OF GRANULATING TENDENCY TO COMPOSITION OF HONEY

Table 8 gives the average composition for all honey samples (excluding honeydew) in each of the 10 classes of granulating tendency.

The data show several general trends. The most striking are the increase in dextrose content as granulating tendency increases, and the constancy of the levulose values.

In order to decide what composition factors affect granulation, an analysis of variance for regression was made of granulating tendency on each of the other 16 factors in table 8. The following listing shows the results in decreasing order of significance.

Factor	F	Direction of change as granulation increases
Dextrose-----	61. 4	Increases.
Maltose-----	26. 7	Decreases.
Moisture-----	22. 4	Do.
Higher sugars-----	20. 5	Do.
Undetermined-----	18. 1	Do.
Sucrose-----	11. 86	Increases.

TABLE 8.—Average composition of honey samples classified by granulating tendency

Extent of granulation	Granulation code	Color ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
			<i>Percent</i>	<i>Months</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		<i>Meq./kg.</i>	<i>Meq./kg.</i>	<i>Meq./kg.</i>		<i>Percent</i>	<i>Percent</i>
Completely liquid.....	1	7	17.5	13	37.48	27.70	0.94	9.38	2.25	4.6	4.04	25.71	6.58	32.29	0.272	0.269	0.050
Few scattered crystals.....		5	17.3	13	38.13	30.44	1.26	7.90	1.72	3.1	3.91	21.55	6.76	28.19	.322	.156	.044
1/16- to 1/8-in. layer.....	2	4	17.6	11	38.27	31.53	1.34	6.83	1.38	2.9	3.84	21.21	7.53	28.74	.357	.142	.037
Few clumps of crystals.....	3	4	17.4	12	38.50	32.45	1.42	6.71	1.09	2.4	3.83	20.03	6.13	26.36	.301	.117	.039
1/4- to 1/2-in. layer.....	4	5	17.8	10	38.39	32.49	1.34	6.40	1.16	2.8	3.84	21.09	8.16	29.24	.399	.133	.038
1/4 of depth granulated.....	5	5	16.9	11	38.83	33.67	1.40	5.91	.99	2.3	3.87	22.84	8.26	31.13	.365	.147	.039
1/2 of depth granulated.....	6	4	16.9	11	38.86	33.38	1.38	6.29	1.03	2.1	3.90	17.41	6.12	23.51	.354	.128	.031
3/4 of depth granulated.....	7	4	16.7	12	38.54	34.39	1.73	5.84	1.02	1.9	3.93	20.60	6.92	27.53	.353	.170	.033
Complete soft granulation...	8	4	16.1	11	38.62	34.85	2.41	5.43	.78	1.8	3.97	17.55	5.56	23.11	.323	.158	.028
Complete hard granulation...	9	5	15.7	13	38.55	35.22	1.65	5.70	.96	2.2	3.93	21.75	7.65	29.40	.364	.162	.044

¹ See p. 6 for explanation of color code.

All values are significant at the 1-percent probability level or less ($F=11.26$). The F value for color was 6.7, significant at the 5-percent level. No other factor varies with granulating tendency in a significant manner.

Thus, we see that dextrose content is the most important consideration in stability of honey in storage. This is expected since the material granulating is dextrose. By examining the other significant factors, we find that as dextrose is low, maltose, higher sugars, and undetermined material are all higher. Since levulose is not varying and all samples approximate the same total sugar content, these other types of sugars must make up the balance.

In the past, several indices have been proposed to express the granulating tendency of honey. The one most used has been the levulose/dextrose (L/D) ratio. High values have been associated with liquid or slow-granulating honey.

The L/D values in the literature may be compared with one another. But in the past reducing disaccharides were included with dextrose; therefore, the values in the literature cannot be compared directly with those reported here, or by Austin (3), who also used the selective adsorption method for sugar analysis.

Jackson and Silsbee (16), on the basis of studies of the solubility relationships of pure solutions of dextrose, levulose, and sucrose, proposed two indices of granulating tendency, the "supersaturation coefficient" and "granulation tendency." Austin has discussed these values; it is sufficient to note that tupelo honey, which is nongranulating, has a supersaturation coefficient of 1.66 calculated by Jackson from Browne's data (9). Even if data presented here are used, including correct dextrose values, tupelo honey is calculated to be highly supersaturated. Part of the difficulty is in the original solubility data of Jackson and Silsbee, on which their calculations are based. They did not extend their data through the composition region of honey, as pointed out by Lothrop.⁵ When calculated using Lothrop's solubility data, tupelo honey shows a supersaturation coefficient of 1 or less. This coefficient is not convenient to calculate; the "granulation tendency" of Jackson and Silsbee is (dextrose—water)÷levulose, and is simpler. They did not find this index to be particularly sensitive when applied to Browne's data.

Austin has proposed a new index of crystallization for honey, the dextrose/water (D/W) ratio, noting that "it falls more logically in line with observed honey behavior than most crystallization indexes" (3). He also suggested that when honeys are to be compared on the basis of their D/W ratio, their composition should be calculated to equivalent moisture contents. Since on the basis of our results moisture content is a significant factor in granulating tendency, we have calculated this index on both bases.

We have calculated several of these indices for each of the average honey compositions in table 8, and carried out an analysis of variance for regression of granulating tendency on L/D ratio, Jackson and

⁵ Lothrop, R. E. SATURATION RELATIONS IN AQUEOUS SOLUTIONS OF SOME SUGAR MIXTURES WITH SPECIAL REFERENCE TO HIGH CONCENTRATIONS. Thesis, George Washington Univ., 1943.

Silsbee's $\frac{D-W}{L}$, and Austin's D/W ratio. As shown below, the index proposed by Austin, not adjusted to a common H₂O content, shows the most highly significant relationship with granulating tendency.

Index	F	r ²
D/W-----	152	95. 0
$\frac{D-W}{L}$ -----	131	94. 2
D/W, common water content-----	91	91. 9
Dextrose-----	61	88. 5
L/D-----	50	86. 3

All these F values exceed the F value for the 1-percent probability level (F=11.26). The D/W ratio, on the natural basis, appears to be the preferable index. These values for the 10 levels of granulating tendency in table 8 are as follows:

Code	Granulation	D/W ratio
0	Liquid-----	1. 58
1	Few scattered crystals-----	1. 76
2	$\frac{1}{16}$ - to $\frac{1}{8}$ -inch layer crystals-----	1. 79
3	Few clumps crystals-----	1. 86
4	$\frac{1}{4}$ - to $\frac{1}{2}$ -inch layer crystals-----	1. 83
5	$\frac{1}{4}$ of depth granulated-----	1. 99
6	$\frac{1}{2}$ of depth granulated-----	1. 98
7	$\frac{3}{4}$ of depth granulated-----	2. 06
8	Complete, soft granulation-----	2. 16
9	Complete, hard granulation-----	2. 24

The purpose of a granulation index is to relate composition of a honey to granulating tendency, in order ultimately to predict such behavior. The calculations just described are based on the average compositions shown in table 9, and not on actual honey samples. To determine whether individual variation is so large that these indices have no practical use in prediction, an analysis of variance for regression of granulating tendency on D/W, $\frac{D-W}{L}$ and on L/D was carried

out for all 490 honey samples. The first two indices gave similar results, though their order was different. Both showed considerably more significant relationship than did the L/D ratio. Since the D/W ratio is simpler to calculate and does not require that levulose be determined, it is preferred for use.

It thus appears that the granulating tendency of a honey can be estimated on the basis of the D/W ratio. Values of 1.7 and lower generally are associated with nongranulating honeys, whereas values of 2.1 and higher predict rapid granulation to a solid. Table 27

shows exceptions to this rule, however. The calculation of dextrose content to a common solids basis before comparison of samples, proposed by Austin, does not appear necessary; in fact, it reduces the spread of values and as seen from the listings above, reduces the significance of the relationship.

RELATION OF COLOR AND COMPOSITION OF HONEY

The color of honey, which ranges from nearly colorless to deep red-amber, is frequently used to form quick (sometimes erroneous) opinions of its other characteristics. Many believe that strength of flavor increases as color deepens. Most of the reports on the composition of honey have noted that certain analytical characteristics appear to vary with color. Browne (9) did not measure color. Eckert and Allinger (12) reported that ash content of California honey increased directly with color, and that acid had "a tendency" to increase similarly. Schuette and his coworkers (34, 36-38) found that the content of ash, potassium, sodium, magnesium, iron, copper, manganese, chlorine, and sulfur was higher in dark honeys than in lighter honeys. The calcium, phosphorus, and silica contents did not vary significantly. The Wisconsin workers (33, 35) also found that both invertase and diastase activities were higher in dark than in light honeys.

Anderson⁶ in an unpublished analysis of 62 South African honey samples, reported that ash and nitrogen content increased with color.

Table 9 shows the average composition of all honey samples falling into each of the 13 color groups used in this work. Free and total acidity, nitrogen, and ash all increase regularly with increasing honey color. An analysis of variance for regression shows that the following factors change as we progress from light honeys to dark honeys. They are listed in decreasing order of significance.

Decreasing:	F	Increasing:	F
Sucrose.....	24.1	Total acid.....	601
Lactone/free acid.....	23.7	Free acid.....	279
Dextrose.....	23.6	Nitrogen.....	97.7
Hydrogen ion concentration.....	23.3	Ash.....	43.0
Levulose.....	15.9	Undetermined.....	26.2
Granulation.....	9.2	Maltose.....	17.8
		Higher sugars.....	6.4

Moisture content, age at analysis, and lactone content do not differ significantly. The critical F value for the 1-percent probability level is 9.65. This is exceeded by all factors listed except granulation and higher sugars; these exceed the 5-percent probability level value of 4.84.

Summarizing.—In comparing the average light honeys with the average dark honeys, the former are significantly higher in simple sugars (dextrose and levulose), sucrose, and tendency to granulate, and show a greater lactone/free acid ratio and hydrogen ion concentration. The darker honeys in general appear to be higher in acidity, nitrogen, ash, and more complex sugars.

⁶ See footnote 2, p. 3.

TABLE 9.—Average composition of honey samples classified by color

Color	Color code	Gran- ulation ¹	Mois- ture	Age	Levu- lose	Dex- trose	Su- crose	Malt- ose	Higher sugars	Un- deter- mined	pH	Free acid	Lac- tone	Total acid	Lac- tone/ free acid	Ash	Nitro- gen
			<i>Per- cent</i>	<i>Months</i>	<i>Per- cent</i>	<i>Per- cent</i>	<i>Per- cent</i>	<i>Per- cent</i>	<i>Per- cent</i>	<i>Per- cent</i>		<i>Meg/ kg.</i>	<i>Meg/ kg.</i>	<i>Meg/ kg.</i>		<i>Per- cent</i>	<i>Per- cent</i>
Light half of water white.....	0	3	16.7	8	38.51	32.59	2.74	6.48	1.16	1.8	3.87	11.83	4.50	16.25	0.363	0.053	0.023
Dark half of water white.....	1	4	16.7	12	38.94	31.79	1.83	7.09	1.40	2.1	3.82	13.65	5.34	18.99	.385	.058	.025
Light half of extra white.....	2	3	17.1	11	38.56	32.38	1.31	6.76	1.44	2.4	3.83	15.36	5.96	21.44	.388	.065	.027
Dark half of extra white.....	3	3	17.1	11	38.33	32.60	1.63	6.54	1.30	2.3	3.79	17.19	6.96	24.15	.388	.084	.030
Light half of white.....	4	3	17.3	12	38.62	32.28	1.38	6.64	1.24	2.5	3.82	20.16	7.67	27.67	.376	.124	.037
Dark half of white.....	5	3	17.6	12	38.32	32.19	1.16	6.78	1.18	2.8	3.87	21.47	7.40	28.89	.339	.128	.039
Light half of extra light amber.....	6	3	17.0	14	38.48	31.32	1.19	7.28	1.41	3.3	3.94	23.63	7.82	31.44	.326	.178	.045
Dark half of extra light amber.....	7	3	17.6	13	38.83	30.85	1.06	7.11	1.21	3.3	3.95	25.37	8.68	34.05	.343	.192	.052
Light half of light amber.....	8	2	17.2	12	37.89	29.76	.99	8.37	1.75	4.0	4.18	26.98	6.82	33.80	.249	.305	.055
Dark half of light amber.....	9	2	17.5	13	36.92	29.96	1.01	8.33	1.89	4.3	4.00	31.01	9.45	40.46	.304	.261	.050
Light half of amber.....	10	1	16.5	14	34.19	26.47	.87	10.45	3.80	7.6	4.44	37.00	4.25	41.25	.121	.503	.073
Dark half of amber.....	11	0	17.4	12	34.96	26.39	.88	10.04	2.64	6.7	4.40	39.24	6.76	46.00	.174	.608	.058
Dark amber.....	12	3	18.9	14	36.34	29.60	.93	8.05	1.63	4.5	4.02	35.77	8.37	44.14	.245	.202	.063

¹ See p. 6 for explanation of granulation code.

HONEYS AVERAGED BY STATE OF ORIGIN

Table 28 (appendix) shows average composition of honey by States and regional areas of the United States. The number of samples in each average is also shown. Honeys of the East and South were darker than the national average; those of the North Central and Intermountain areas were lighter. The North Central honeys were somewhat higher in moisture content, while the Intermountain and Western honeys were heavier bodied; this was also noted by Browne (9).

With respect to granulating tendency, the honeys of the South Atlantic States had the least, and the North Atlantic honeys were next. The predominately alfalfa-clover type from the Intermountain area gave this group the greatest tendency to granulate.

HONEYS AVERAGED BY PLANT FAMILY

The average composition of honey samples from various plant sources is given in appendix table 27. Table 29 lists average values of all samples of honey and honeydew from each of 33 plant families. These averages include only honeys from single plant sources, not blends. The number of samples included in each average is also given. Even if the families with only one or two samples analyzed are eliminated, pronounced differences among the averages for the families may be noted in all constituents.

EFFECT OF STORAGE ON HONEY COMPOSITION

Honey is considered to be a relatively stable foodstuff, with only minor changes in flavor and color taking place during several years of storage. It is well known that properly ripened honey is not susceptible to spoilage by micro-organisms, with the exception of osmophilic yeasts, and then only at moisture contents above 17 percent (21, 39). Granulation of honey increases the possibility of spoilage, since it results in an increase in the moisture content of the liquid portion. A comprehensive study of the effect of storage at elevated temperature and of heat processing on the color of honey has been described by Milum (26).

Both physical and chemical actions are involved in the transformation of nectar to honey, with the activity of enzymes being most prominent. Since these enzymes remain in the honey, their action may continue at a declining rate. The decrease in the sucrose content of honey after extraction has long been ascribed (9, 17) to a continuing action of the invertase added by the bee. However, the sucrose content of a honey does not reach zero even after several years of storage, although it may still contain active invertase.

It was recently shown (53) that honey contains a transglucosylase which produces several oligosaccharides, including maltose and isomaltose, from sucrose. Austin pointed out (3) that because of this enzymic activity the "maltose" (actually reducing disaccharide) content of a honey depends to some degree on methods of apiary management, storage temperature, and density of honey. He did not

predict the effect of storage in general on the maltose content of honey.

de Boer (6) examined a number of honey samples that had been stored for up to 22 years; nearly all were white clover and all were stored in the unheated state. He pointed out that the same changes in composition that occur on heating of honey also occur in storage. He concluded that polarization is unchanged and the change in sucrose content negligible, implying no changes in the sugars. He stated that the amounts of glucose and fructose and their ratio remained unchanged; and, contrary to previous reports (2), no relative increase was noted in fructose content. Diastase decreased with age—3 Gothe "steps" in 10 years. The acidity was unchanged, but the Fiehe test for hydroxymethylfurfural (HMF) became positive and after 10 years HMF could be determined gravimetrically.

Armbruster (quoted by de Boer (6)) reported that aging for as short a period as 2½ months sometimes causes a noticeable decrease of diastatic activity, while other types of honey show no loss after as long as 5 months. After 2½ years, a considerable decrease was found in one type of honey.

We have reexamined the effects of storage on the composition of honey. We have studied the effect of storage at room temperature for up to 3 years on unheated and mildly heated honey, determining changes in dextrose, levulose, maltose (reducing disaccharides), sucrose, higher sugars, diastase, free acidity, lactone, and total acidity. Contrary to previous beliefs, significant changes were found for nearly all these constituents.

For this work, unheated samples were used. On receipt they were divided into three portions: one was stored at -20°C . (-4°F .) within 1 day of receipt, a second heated in a closed jar in a water bath at 55°C . (131°F .) for 30 minutes and cooled (essential pasteurization without enzyme inactivation), and the remainder left unheated. The latter two portions were stored in the dark at room temperature (23° – 28°C ., 73° – 82°F .). Samples from frozen storage were allowed to reach room temperature overnight before analysis. Analyses of corresponding samples of a set were carried out on the same day; sets were selected at random.

Carbohydrates

Table 10 shows the values obtained for each type of storage for five honey samples, each set calculated to the moisture content shown for the cold-storage sample.

The data in table 10 were subjected to the analysis of variance. Each set of 15 values for each sugar was examined, and the variability due to sample and storage was calculated and tested statistically. All differences due to storage were significant at the 1-percent probability level, except for the unanalyzed portion, where the change is significant at the 5-percent probability level.

The mean square resulting from storage conditions was further subdivided; that of frozen storage was compared with that of the two

TABLE 10.—*Effect of storage on honey sugars*¹

Sample No. and kind of storage ²	H ₂ O ³	Levu-lose	Dex-trose	Malt-ose	Su-crose	Higher sugars	Unan-alyzed	Age ⁴
91:	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Months</i>
F-----	18.6	35.85	33.87	4.92	0.58	1.28	4.90	20
H-----	(17.5)	35.07	29.82	8.94	.93	1.46	5.18	20
R-----	(16.6)	34.85	29.44	9.22	.89	1.45	5.55	20
258:								
F-----	20.8	35.95	32.31	5.43	.28	1.71	3.62	22
H-----	(19.0)	33.95	27.88	9.59	.85	1.67	5.26	22
R-----	(19.3)	33.84	27.81	10.18	.92	2.03	4.42	22
94:								
F-----	17.4	38.22	31.29	7.54	.73	1.23	3.59	22
H-----	(16.2)	36.39	28.54	11.02	.87	2.36	4.42	22
R-----	(16.6)	36.23	28.55	10.51	.90	1.46	4.95	22
96:								
F-----	17.7	36.36	29.85	7.64	.78	1.77	5.79	23
H-----	(16.0)	34.19	25.39	13.13	.85	1.91	6.93	23
R-----	(14.2)	34.49	25.24	13.05	.99	2.05	6.48	23
98:								
F-----	18.5	37.98	31.02	6.83	.44	1.84	3.39	23
H-----	(17.0)	36.10	28.02	10.95	1.00	1.82	3.61	23
R-----	(16.8)	35.73	26.71	11.47	1.16	1.93	4.50	23
Average:								
F-----	18.8	36.89	31.67	6.47	0.56	1.57	4.26	-----
H-----	-----	35.14	27.93	10.73	.90	1.64	5.08	-----
R-----	-----	35.03	27.55	10.89	.97	1.78	5.18	-----
Change in—								
Heated								
honey-----	-----	-1.75	-3.74	+4.26	+ .34	+ .07	- .82	-----
Unheated								
honey-----	-----	-1.86	-4.12	+4.42	+ .41	+ .21	- .92	-----
Unheated,								
percent-----	-----	5.5	13.0	68	73	13.4	22.2	-----

¹ Each set of values calculated to the moisture content of corresponding cold-storage sample.

² Storage conditions are identified as follows: F=unheated, cold storage; H=heated, room-temperature storage; R=unheated, room-temperature storage.

³ Moisture values in parentheses are actual values found for the samples.

⁴ Months sample was in storage after receipt at the laboratory.

room-temperature storage conditions. The two room-temperature storage sets (heated and unheated) were also compared with each other. A sample calculation is shown in table 11, and table 12 summarizes the mean squares and the F values obtained therefrom, for each sugar.

The table shows that the differences between the frozen samples and those stored at room temperature are significant for all sugars at the 1-percent probability level. None of the differences between the average values in table 10 for the unheated and heated samples, both stored at room temperature, are significant, except the values for higher sugars, which are significant at the 5-percent probability level.

TABLE 11.—*Effect of storage on dextrose content—analysis of variance*

Source of variability	S.S	D.F.	M.S.	F ¹
Total-----	72. 00	14		
Storage ¹ -----	51. 79	2	25. 89	99. 6**
F vs. R & H-----	51. 43	1	51. 43	198**
R vs. H-----	. 36	1	. 36	1. 4
Samples-----	28. 14	4	7. 03	27. 0**
Error-----	2. 07	8	. 26	

¹ Storage conditions are identified as follows : F-unheated, cold storage; H-heated, room-temperature storage; R-unheated, room-temperature storage.
**Exceeds 1-percent probability level.

TABLE 12.—*Significances of changes in honey composition due to storage*

Source of variability	D.F.	Levulose		Dextrose		Maltose	
		M.S.	F	M.S.	F	M.S.	F
Samples-----	4	3. 18	31. 8**	7. 03	27. 0**	5. 71	22. 0**
Storage ¹ -----	2	5. 46	54. 6**	25. 9	99. 6**	31. 3	120**
F vs. R & H-----	1	10. 90	109**	51. 4	198**	62. 6	241**
R vs. H-----	1	. 03	0	. 36	1. 4	. 06	. 2
Error-----	8	. 10		. 26		. 26	

Source of variability	D.F.	Sucrose		Higher sugars		Unanalyzed	
		M.S.	F	M.S.	F	M.S.	F
Samples-----	4	0. 018	0. 86	0. 217	36. 2**	3. 03	17. 8**
Storage ¹ -----	2	. 240	11. 4**	. 061	10. 2**	1. 33	7. 8*
F vs. R & H-----	1	. 466	22. 2**	. 073	12. 2**	2. 63	15. 5**
R vs. H-----	1	. 013	. 62	. 049	8. 2*	. 02	. 1
Error-----	8	. 021		. 006		. 17	

¹ Storage conditions are identified as follows: F-unheated, frozen storage; H-heated, room-temperature storage; R-unheated, room-temperature storage.
*Exceeds 5-percent probability level.
**Exceeds 1-percent probability level.

These analyses show that when unheated honey is stored for 2 years at temperatures ranging between 23° and 28° C., the following changes take place in the carbohydrate composition:

1. A decrease of free dextrose (averaging 13 percent) and a decrease of free levulose (averaging 5.5 percent); an average of 18.5 percent of the free monosaccharide content of the honey is thus lost.
2. A marked increase of "maltose" or reducing disaccharide sugars, averaging 68 percent of the amount initially present.
3. A *relatively* large increase in sucrose content.

4. A small (13 percent) increase in the higher sugar content of the honey.

5. An increase, averaging 22 percent, in the amount of unanalyzed material (100—sugars+water).

The heat treatment given these samples (55° C., 130° F.) for 30 minutes) had no effect on these changes, except possibly to reduce the extent of increase of the higher sugar values. The changes in the stored samples are in the direction of increased complexity of sugars. This might be expected from the conditions within the sample. A high sugar concentration and a considerable acidity over a period of time would promote combination of monosaccharides (reversion, (30, pp. 434, 515, 605).). The presence of an active transglucosylase enzyme (53) in the honey may also result in accumulation of oligosaccharide material; the heat treatment used was not sufficient to inactivate enzymes. Possible explanations for the changes observed are as follows:

LEVULOSE.—This sugar is subject to degradation to hydroxymethylfurfural by long standing in acid solution. Conversion to nonreducing fructose anhydrides is also possible. Levulose-containing oligosaccharides may result from enzyme transfer of dextrose to a levulose acceptor.

DEXTROSE.—Twice as much dextrose disappeared as did levulose. This may reflect the specificity of the enzyme transferring dextrose from oligosaccharides (honey invertase, a glucoinvertase).

"MALTOSE".—This actually represents reducing disaccharide material, including maltose, isomaltose, maltulose, turanose, and nigerose (51). All these sugars are hydrolyzed by honey α -glucosidase.⁷ The increase in this category of sugars accounts for most of the decrease in monosaccharides.

SUCROSE.—Postharvest ripening has long been known to take place in unheated honey (9, 17). Sucrose reaches a low value within a few months after honey is removed from the hive, but never disappears completely, despite (or probably because of) the presence of an active invertase. The data here show a later change in the amount of sucrose, where it increases toward 1 percent. Mold enzymes have been shown to resynthesize sucrose by transfructosylation during their hydrolytic action on sucrose (13).

HIGHER SUGARS.—The increase in this fraction is further evidence of reversion and transglucosylation.

UNANALYZED.—From the point of view of the carbohydrates, the unanalyzed category can contain difructose anhydrides, nonreducing disaccharides (except sucrose), and kojibiose, a very weakly reducing disaccharide (2-O- α -D-glucosyl-D-glucose) recently discovered in honey by Watanabe and Aso (47). This sugar is not determined in the analytical procedure used, since it has only about 6 percent of the reducing power of glucose against copper reagents. The increase in unanalyzed material may represent an increase in the amount of kojibiose (and possibly trehalose) in honey. Both of these compounds have been isolated from hydrol, where it is believed that they arose by reversion from dextrose (31, 42).

⁷ WHITE, J. W. JR. Unpublished data.

EFFECT OF LONG-TERM STORAGE.—An analysis of a 35-year-old sample of honey is compared with a corresponding contemporary sample in table 13. The 1923 sample⁸ is an alsike clover-white clover honey produced at Delphos, Ohio. It had been stored in a dark cupboard and never been opened; it was liquid except for a few coarse crystals at the bottom. The 1957 sample is an alsike clover-white clover honey (sample 175), produced at Columbia City, Ind. To facilitate comparison, data were calculated to the same moisture content. The differences shown in the table are all similar in trend to those in table 10, except that the 1957 sucrose value is higher, though the value for the aged sample (equilibrium?) is close to the average of the 2-year-old samples. In general the changes in monosaccharide and "maltose" shown after 35 years of storage are similar to, but larger than, for the 2-year-old samples in table 10.

Analysis of honey samples after extended storage have been reported by de Boer (6) and Auerbach and Bodländer (2). The analytical methods de Boer used would not detect the differences in carbohydrate composition shown here. He did not confirm the earlier conclusion of Auerbach and Bodländer that the ratio of levulose to dextrose increased after storage of honey. Auerbach and Bodländer reported the analysis of 13 samples of 14-year-old honey. Their levulose/dextrose ratio ranged from 1.19 to 1.81, and averaged 1.40; 10 samples of fresh honey ranged from 1.06 to 1.19 and averaged 1.11. These values have only relative meaning, since the analytical methods used gave no differentiation between monosaccharide and disaccharide.

The results in tables 10 and 13 substantiate the views of Auerbach and Bodländer that the amount of free dextrose decreases on storage and that the ratio of levulose to dextrose increases. They ascribed this to possible enzymic condensation of dextrose, which we also believe is a contributing factor.

TABLE 13.—*Effect of age on a clover honey*

Items compared	1957 crop	1923 crop	Difference	
			Actual	Percentage of 1957
	Percent	Percent	Percent	Percent
Moisture-----	18. 2	¹ (18. 2)		
Levulose-----	38. 25	35. 05	-3. 20	-8. 3
Dextrose-----	33. 58	23. 12	-10. 29	-30. 6
Maltose-----	5. 50	16. 41	+10. 91	+198
Sucrose-----	1. 68	1. 04	- . 64	-38. 2
Higher sugars-----	. 82	2. 06	+1. 24	+151
Undetermined-----	2. 0	4. 1	+2. 1	+105

¹ Moisture content of the 1923 sample was 17.6 percent; data are calculated to the 18.2 percent shown by the 1957 sample to facilitate comparison. Samples analyzed in late 1958.

⁸ Donated by C. A. Reese, Department of Entomology, Ohio State University.

The changes described in the sugar distribution of honey have some practical implications. With the tendency toward increasing complexity, there may be a corresponding loss of nutritive value; some of the disaccharides and higher sugars may not be digestible.

The considerable decrease in dextrose content is probably responsible for the gradual liquefaction that is often noted in finely granulated honey samples as they stand in storage. If the dextrose content of a granulated honey is near the lower limit of granulation, the changes in a year or so will reduce the dextrose well below the saturation point so that the crystals will slowly dissolve. Figure 5 shows a jar of 4-year-old honey, originally completely granulated, which is slowly liquefying during storage.

This may explain the changes in texture that are known to occur in finely granulated honey (honey spread) during storage. If the storage temperature is high enough to affect the texture of such a spread adversely by its effect on the solubility of dextrose, this will be immediately apparent. The changes in sugar content described here take place very slowly, and at temperatures previously considered safe for storage of finely granulated honey spread. Over a period of, say, 6 to 12 months the D/W ratio in the spread can change sufficiently to cause serious softening and quality loss. Such spreads

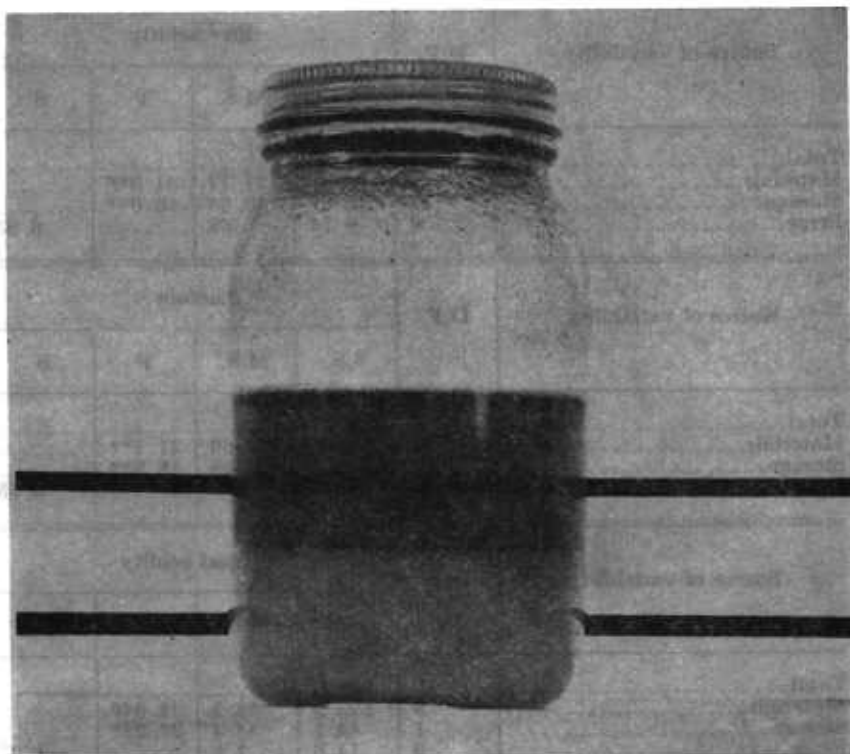


FIGURE 5.—Honey sample showing partial liquefaction during storage.

TABLE 14.—*Effect of storage on acidity of honey*¹

Sample No.	Free acid		Lactone		Total acidity	
	F ¹	R ²	F ¹	R ²	F ¹	R ²
	<i>Meq./kg.</i>	<i>Meq./kg.</i>	<i>Meq./kg.</i>	<i>Meq./kg.</i>	<i>Meq./kg.</i>	<i>Meq./kg.</i>
91.....	24. 04	27. 07	9. 87	12. 39	33. 92	39. 46
258.....	20. 56	24. 06	6. 45	7. 73	27. 00	31. 80
92.....	19. 85	21. 66	4. 90	5. 32	24. 35	26. 98
94.....	15. 04	15. 78	2. 55	2. 62	17. 59	18. 40
96.....	22. 28	23. 90	6. 17	9. 21	28. 45	33. 11
107.....	23. 73	24. 88	2. 20	2. 18	25. 93	27. 04
97.....	20. 82	20. 13	7. 00	8. 08	27. 82	28. 21
108.....	22. 88	24. 29	1. 90	4. 21	24. 78	28. 46
109.....	25. 24	26. 45	5. 83	7. 68	31. 05	34. 13
98.....	25. 62	26. 63	8. 33	10. 39	33. 85	37. 02

¹ F=stored at -20° C; samples 91-96 and 258, 21 months; others 24 months.² R=stored at room temperature same times as above.TABLE 15.—*Effect of storage on acidity—analysis of variance*

Source of variability	D.F.	Free acidity			
		S.S.	M.S.	F	S
Total.....	19	207. 6	-----	-----	-----
Materials.....	9	190. 6	21. 17	31. 0**	-----
Storage.....	1	10. 9	10. 93	16. 0**	-----
Error.....	9	6. 14	. 68	-----	0. 83

Source of variability	D.F.	Lactone			
		S.S.	M.S.	F	S
Total.....	19	175. 0	-----	-----	-----
Materials.....	9	159. 2	17. 69	31. 1**	-----
Storage.....	1	10. 7	10. 68	18. 8**	-----
Error.....	9	5. 11	. 57	-----	0. 75

Source of variability	D.F.	Total acidity			
		S.S.	M.S.	F	S
Total.....	19	582. 6	-----	-----	-----
Materials.....	9	523. 9	58. 2	35. 9**	-----
Storage.....	1	44. 1	44. 1	27. 2**	-----
Error.....	9	14. 6	1. 6	-----	1. 27

**Exceeds 1-percent probability level.

cannot be salvaged by reprocessing, since their composition has changed. On the other hand, texture lost by short-time high-temperature storage, resulting only in solution of the dextrose, could be restored by reprocessing.

The slow decrease of D/W ratio due to loss of dextrose will not be an important factor in quality loss if the initial ratio is sufficiently high. However, a too-high ratio would yield an excessively hard product.

Acids

Table 14 shows the free acidity, lactone content, and total acidity of 10 samples stored under the conditions described above. None of the samples showed visible evidence of fermentation. Table 15 gives the analysis of variance for the free acidity, lactone, and total acidity values. The average changes in each of these categories are seen to be highly significant. Cocker (10) and White (49) proposed that an enzyme producing acidity occurs in honey. If this is the case, honey samples with high diastase number might be expected to show a correspondingly high rate of acid production. These values for 10 honey samples are given in table 16. Also in the table is an analysis of variance for regression. The F value obtained, 11.5, demonstrates a highly significant regression between the two sets of values. This is not meant to imply that amylase is responsible for acid production, but rather that the factors affecting amylase activity also influence the activity of the acid-producing enzyme.

TABLE 16.—Regression of acid production by honey on diastase value

Sample No.	Diastase value	Change in total acidity per year
		<i>Meq./kg.</i>
91.....	38.0	3.16
258.....	35.3	2.74
92.....	33.3	1.50
94.....	19.1	.46
96.....	27.8	2.66
107.....	18.5	.59
97.....	8.0	.18
108.....	20.0	1.84
109.....	10.7	1.59
98.....	21.7	1.58

Analysis of variance for regression

Source	S.S.	D.F.	M.S.	F
Total.....	927.28	9		
Linear regression.....	546.99	1	547	11.5**
Deviations.....	380.29	8	47.5	

**Significant at 1-percent probability level.

Diastase

The amylase (diastase) content of honey has long been used by Europeans as a measure of the heat treatment to which a honey has been exposed. The voluminous literature will not be reviewed here (4, 6, 11, 18-20, 23, 32, 35, 46). Recently (11, 18), it has been proposed that diastase content alone is not a suitable criterion for the detection of overheated honey.

There appears to be relatively little information in the literature on the effect of storage of honey on its diastase content. de Boer (5), using the Gothe procedure, reported that diastase decreased gradually with age of honey—about 3 Gothe “steps” in 10 years. Schade, Marsh, and Eckert, (32) using their improved procedure, reported diastase value for eight honey samples before and after storage for 13 to 15 months at 20° C. They reported that the diastase activity had “decreased slightly but not significantly in most cases.” We have subjected their data (the seven samples in their table 3) to the analysis of variance, and the changes were significant at the 1-percent probability level ($F = 11.7$). Their data for seven samples showed an average decrease of 10.1 percent in diastase value after storage for the approximately 14 months at 20° C., or 0.72 percent per month.

TABLE 17.—*Effect of storage on diastase content of honey*

Sample No.	Storage time	Diastase value		Loss	Loss per month
		Frozen	Room temperature		
	<i>Months</i>			<i>Percent</i>	<i>Percent</i>
234-----	21	61. 2	30. 9	49. 5	2. 36
430-----	20	32. 6	18. 6	42. 9	2. 16
361-----	20	14. 6	8. 11	44. 5	2. 23
326-----	19	17. 6	7. 23	59. 1	3. 11
238-----	17	10. 6	7. 59	28. 3	1. 66
403-----	13	6. 74	3. 97	41. 1	3. 16
91-----	13	38. 0	21. 8	42. 6	3. 28
258-----	13	35. 3	20. 8	41. 1	3. 16
92-----	13	33. 3	19. 0	42. 9	3. 30
94-----	13	19. 1	12. 9	32. 5	2. 50
96-----	13	27. 8	18. 4	33. 8	2. 60
97-----	13	8. 00	4. 42	44. 7	3. 44
98-----	13	21. 7	15. 8	27. 2	2. 09
261-----	13	10. 3	8. 40	18. 4	1. 41
142-----	13	22. 4	13. 2	41. 1	3. 16
104-----	9	10. 8	8. 15	24. 5	2. 72
121-----	8	22. 6	15. 9	29. 6	3. 70
179-----	8	16. 7	11. 4	31. 7	3. 96
333-----	8	15. 2	9. 38	38. 1	4. 76
214-----	4	15. 2	12. 8	15. 8	3. 95
Average-----	13. 2	22. 0	13. 4	38. 9	2. 95

We have determined diastase value for aliquots of 20 samples of honey after dark storage for 4 to 21 months at -20° C. and also at laboratory room temperature (table 17). Samples were from the 1956 and 1957 crops and were frozen on receipt at the laboratory at varying times ($\frac{1}{2}$ to 14 months) after their extraction. The data are based on the reasonable assumption that no change takes place in samples stored at -20° C. This table shows an average loss in diastase value of 2.95 percent per month, for honey stored unheated at temperatures ranging from about 23° to 28° C. This is equivalent to a half-life of 17 months.

This loss may be compared to the 0.72 percent per month shown by the data of Schade et al. for a temperature probably 5° to 6° C. lower. This at once emphasizes the importance of low-temperature storage for honey in which diastase content must be maintained. Our data show a considerable variation in the rate of loss of diastase among the honey samples. Kiermeier and Koberlein (18) reported that the heat sensitivity of honey diastase is related to the pH of the sample; Schade, Marsh, and Eckert (32) agree.

We made an effort to relate several compositional factors to the rate of loss of diastase in storage, but no relationship was obtained for ash, total acidity, hydrogen ion concentration, original diastase value, and moisture content (table 18). An analysis of variance for regression on the values for diastase loss versus original diastase value, for example, gave an F value of 2.66, significant at the 10-percent probability level. However, rate of loss was correlated with storage time; the rate for samples stored for short periods was significantly greater than the overall rate for samples stored for longer periods. Analysis of variance of these data yields an F value for linear regression of 12.4, significant at the 1-percent probability level. A less significant relation was found between total age and rate of diastase loss. This does not provide information on the composition factors controlling rate of loss.

These data and also those of Schade and coworkers show that storage temperature is a most important factor affecting retention of diastase in honey. Many workers have reported studies relating diastase loss to degree of heating (4, 11, 18-20, 23, 32, 46) investigating the thesis that diastatic activity is an indication of heating of

TABLE 18.—*Correlation of diastase loss rate with other factors*

Factor	F value ¹
Time of storage.....	12.4**
Original diastase value.....	² 2.7
Moisture content.....	.1
Total acidity.....	.5
Hydrogen ion concentration.....	.07
Ash.....	1.9
Total age.....	7.6*

¹ Calculated by analysis of variance for regression.

² Significant at 10-percent probability level.

*Exceeds 5-percent probability level.

**Exceeds 1-percent probability level.

honey. de Boer in his study of aging of honey did note that in general the changes that occur as honey ages are the same as those brought about by heating; he had particular reference to increase in hydroxymethylfurfural content. We have now, for the first time, evidence that over a storage period of 12 to 18 months, without heating, a honey may lose enough diastase to fall below the minimum values required for European acceptance as table honey.

OFFICIAL DEFINITION OF HONEY

Under the original Federal Food and Drugs Act of 1906, the following definition and standard for honey was in force (44):

1. **HONEY.** The nectar and saccharine exudations of plants gathered, modified, and stored in the comb by honeybees (*Apis mellifica* and *A. dorsata*). Honey is levorotatory and contains not more than 25 percent of water, not more than 0.25 percent of ash, and not more than 8 percent of sucrose.
2. **COMB HONEY.** Honey contained in the cells of comb.
3. **EXTRACTED HONEY.** Honey which has been separated from the uncrushed comb by centrifugal force or gravity.
4. **STRAINED HONEY.** Honey removed from the crushed comb by straining or other means.

This statement represents the current view of the Food and Drug Administration as to what honey should be, but it now has an advisory status rather than the status of a definition and standard for a food established under Section 401 of the present Federal Food, Drug, and Cosmetic Act.⁹ There is no definition and standard for honey under the present Act.

If the analytical results in table 1 are examined with these limits in mind, it appears that the moisture limit of 25 percent is too high. The 8-percent limit for sucrose is not exceeded by any of the samples; a 7-percent limit would be exceeded by only one sample. The 0.25-percent limit for ash content appears to be too low. It is exceeded by 103 (21 percent) of the 490 samples that were classified as honey by their producers. Feinberg (15) has also noted that the 0.25-percent limit for ash is unrealistic. It is not needed to distinguish honey from honeydew, since there are other criteria for this purpose.

SUMMARY AND CONCLUSIONS

1. The results of physical and chemical examination are given and discussed for 504 samples of honey and honeydew from 47 States. They represent 83 single floral types, 93 blends of known composition, and 4 types of honeydew, all from the 1956 and 1957 crop years. The analyses carried out and the average values for 490 honey samples are: color, dark part of "White"; granulating tendency, $\frac{1}{8}$ - to $\frac{1}{2}$ -inch layer; moisture, 17.2 percent; levulose, 38.19 percent; dextrose, 31.28 percent; sucrose, 1.31 percent; "maltose" (reducing disaccharides), 7.31 percent; higher sugars, 1.50 percent; pH, 3.91; free acidity, 22.03 meq./kg.; lactone, 7.11 meq./kg.; total acidity, 29.12 meq./kg.; lac-

⁹ Osborn, R. A., Division of Food, Food and Drug Administration. Private communication.

tone/free acid ratio, 0.335; ash, 0.169 percent; nitrogen, 0.041 percent; and diastase, 20.8. A limited number of melezitose determinations was also made.

2. The analytical values for 74 types and blends of honey and honeydew were compared with averages.

3. All honey samples showed the same pattern of sugars present when examined by paper chromatography. Considerable variation was noted in the relative amounts of the various minor sugars.

4. Lactone material is a general constituent of honey; the ratio of lactone to free acidity (average, 0.335) is closely related to the pH of the honey. Honeydew with higher pH shows lower values (average 0.127) for the ratio.

5. The pH of honey was found to be related to its ash content rather than to the titratable acidity.

6. Where comparisons were made of the same floral types of honey as produced in the two crop years, relatively small or no differences were apparent. Dextrose content and granulating tendency showed significant differences in some cases.

7. Not enough samples were available for definitive comparison of the effect of area of production on composition. Comparisons of averages for alfalfa honey (Intermountain versus Imperial Valley), cotton honey (Arizona, California, and Texas), and orange honey (California versus Florida) were made. Differences due to location were very minor and, where tested, not statistically significant.

8. Samples were grouped into 10 classes of granulating tendency, and the relationship of the average composition of each group to its granulating tendency was examined. It was shown statistically that dextrose content is most closely related, with levulose content showing no relation to granulating tendency.

9. As an index to predict the granulating tendency of honey the dextrose/water ratio of Austin is of most practical value, being more useful than the old levulose/dextrose ratio. D/W values of 1.7 and lower are generally associated with nongranulating honey while values of 2.1 and above predict rapid granulation to a solid.

10. It is statistically confirmed that dark honeys contain higher ash (mineral) and nitrogen content than light honeys. They also have lower sucrose, lactone/free acid, dextrose, and levulose content. Dark honeys are higher in total acid, free acid, maltose, higher sugars, and pH.

11. When honey samples are averaged by state of origin, it is seen that honeys from the East and South are darker than average, and those from the Intermountain and North Central regions lighter. North Central honeys are higher in moisture, with Intermountain samples more heavy-bodied. Honey from the South Atlantic States granulates least, while the predominating alfalfa-clover types give the Intermountain honey the greatest granulating tendency.

12. Average composition of 251 "single"-source samples grouped into 33 plant families is given.

13. Although it is a relatively stable commodity, honey is subject to chemical, physical, and biological change even when stored at 73° to 82° F. During 2 years of such storage about 9 percent of the monosaccharides are converted per year into more complex disaccha-

rides and higher sugars. The free-dextrose content declines twice as rapidly as does the free levulose. All samples examined in the storage study showed such changes.

14. Significant increases were noted in acidity during storage, but some samples showed no change. Evidence for possible enzymic nature of this change is given.

15. Diastase values of unheated honey decline in room-temperature storage (23–28° C.), with diastase showing a half-life of 17 months under these conditions.

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APPENDIX

ANALYTICAL PROCEDURES

Full details of all analytical methods used and pertinent reference material are included here. Sufficient information is included to allow such analyses to be made substantially without outside reference. Many of the methods are those of the Association of Official Agricultural Chemists and appear in the ninth edition of the Book of Methods.

Moisture

Refractive index was determined on an Abbé refractometer at 20° C. (68° F.); moisture content was obtained from data in table 19.

TABLE 19.—*Refractive index and moisture content of honey*¹

n _D ²⁰	Moisture	n _D ²⁰	Moisture	n _D ²⁰	Moisture
	<i>Percent</i>		<i>Percent</i>		<i>Percent</i>
1. 5041	13. 0	1. 4955	16. 4	1. 4871	19. 8
35	. 2	50	. 6	66	20. 0
30	. 4	45	. 8	62	. 2
25	. 6	40	17. 0	58	. 4
20	. 8	35	. 2	53	. 6
15	14. 0	1. 4930	. 4	49	. 8
10	. 2	25	. 6	1. 4844	21. 0
05	. 4	20	. 8	28	21. 5
1. 5000	. 6	15	18. 0	15	22. 0
1. 4995	. 8	10	. 2	02	22. 5
90	15. 0	05	. 4	1. 4789	23. 0
85	. 2	1. 4900	. 6	77	23. 5
80	. 4	1. 4895	. 8	64	24. 0
75	. 6	90	19. 0	52	24. 5
70	. 8	85	. 2	39	25. 0
65	16. 0	80	. 4	26	25. 5
60	. 2	76	. 6	1. 4714	26. 0

¹ Moisture values from 13.0 to 21 percent are from AOAC(1). Extrapolation and dilution of known samples were used by authors to extend range to 26 percent.

Color

Color was estimated with the USDA honey color classifier. The instrument is commercially available and is shown in figure 6.

The color comparators containing the permanent glass color standards are all-metal boxes having dimensions approximately 8 by 2 by 3 inches, divided by thin partitions into five square compartments,

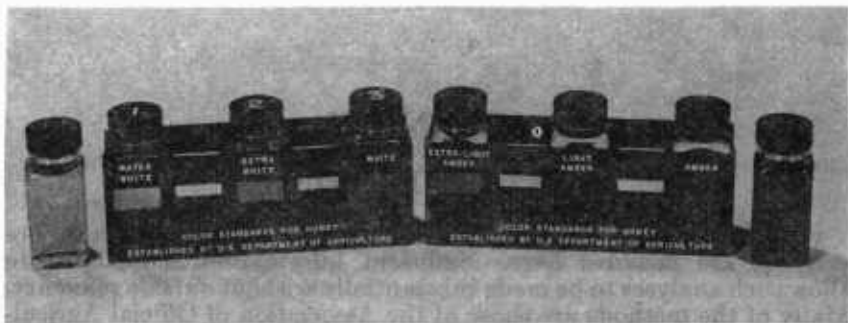


FIGURE 6.—U.S. Department of Agriculture honey color classifier.

each of which has two windows approximately 1.2 inches square. The three lighter glass standards (Water White, Extra White, and White) are mounted in one of the comparator boxes on a shelf against the front windows in compartments 1, 3, and 5. The three darker standards (Extra Light Amber, Light Amber, and Amber) are mounted in a similar manner in a second comparator box. Three 2-ounce square sample bottles of $1\frac{1}{4}$ inches (31.5 mm. internal thickness) filled with distilled water (referred to as "blanks") are placed in the compartments behind the glass standards in the comparator being used for grading. A similar bottle containing honey to be classified is placed in the appropriate comparator in either compartment 2 or 4 so that it will be between adjacent standards. To assist in the classification of honeys which are appreciably turbid, three square bottles are provided containing suspensions of diatomaceous earth in distilled water containing 0.5% carboxymethylcellulose and 0.1% sorbic acid. These are referred to as "Cloudy 1," "Cloudy 2," and "Cloudy 3," and are used interchangeably with any one of the clear blanks to reduce the brightness of a glass standard to a level near that of the honey to be classified.

Use the following procedure in classifying extracted honey with these comparators:

- (1) Place the clear blanks or the cloudy suspensions in back of the glass standards in compartments 1, 3, and 5 of one or both of the comparators.
- (2) Pour the honey to be classified, which must be free of granulation, into a clean dry bottle. Then place the bottle in compartment 2 or 4 of either comparator box.
- (3) Hold the comparator at a convenient distance from the eye and view it by diffused light (e.g., by north sky, overcast sky, or diffused artificial light source provided by a tungsten lamp or a white or daylight fluorescent lamp). Then determine the color classification of the honey by comparing the sample with the standards. Switching the sample from compartment 2 to 4, or vice versa, interchanging the clear blanks and the appropriate cloudy suspension, and in some cases shifting to the second comparator or using both comparators, may be necessary.

The standard glasses represent the upper grade limits, or the "darkest" color permitted in the color class named above each glass. If a sample is equal to or lighter than a glass (White, for example), but not lighter than the next lighter glass (Extra White, for example), it is placed in the former class; in this example, White. Honey darker than the Amber glass is classified Dark Amber.

Most honeys are appreciably cloudy because of the presence of air bubbles and fine suspended matter. The brightness of such a sample is lowered, and its color classification may be difficult to determine, particularly if its hue is near that of one of the color standards. Its color classification will be more easily determined if the clear blank is replaced by one of the cloudy suspensions.

Granulation

The procedure is fully described earlier in this bulletin. The polariscope referred to was constructed for detecting incipient granulation in honey. A drawing of the device is shown in figure 7.

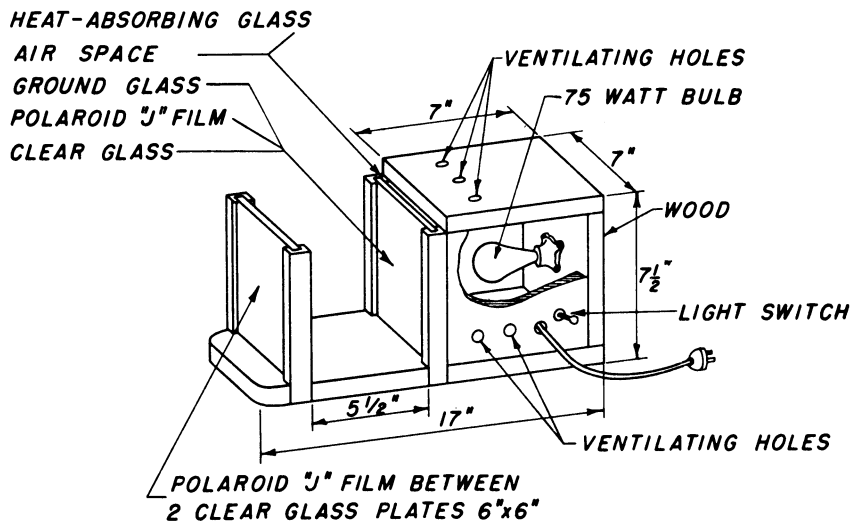


FIGURE 7.—Polariscope for observing crystallization in honey.

Carbohydrate Analysis

By adsorption of honey sample on charcoal, followed by elution into monosaccharide, disaccharide, and higher sugar fractions, interference of disaccharides in dextrose and levulose determinations is eliminated. Elution is by progressively higher EtOH concentrations, followed by determination of individual monosaccharides, sucrose, reducing disaccharides collectively as maltose, and trisaccharides and higher sugars collectively after hydrolysis.

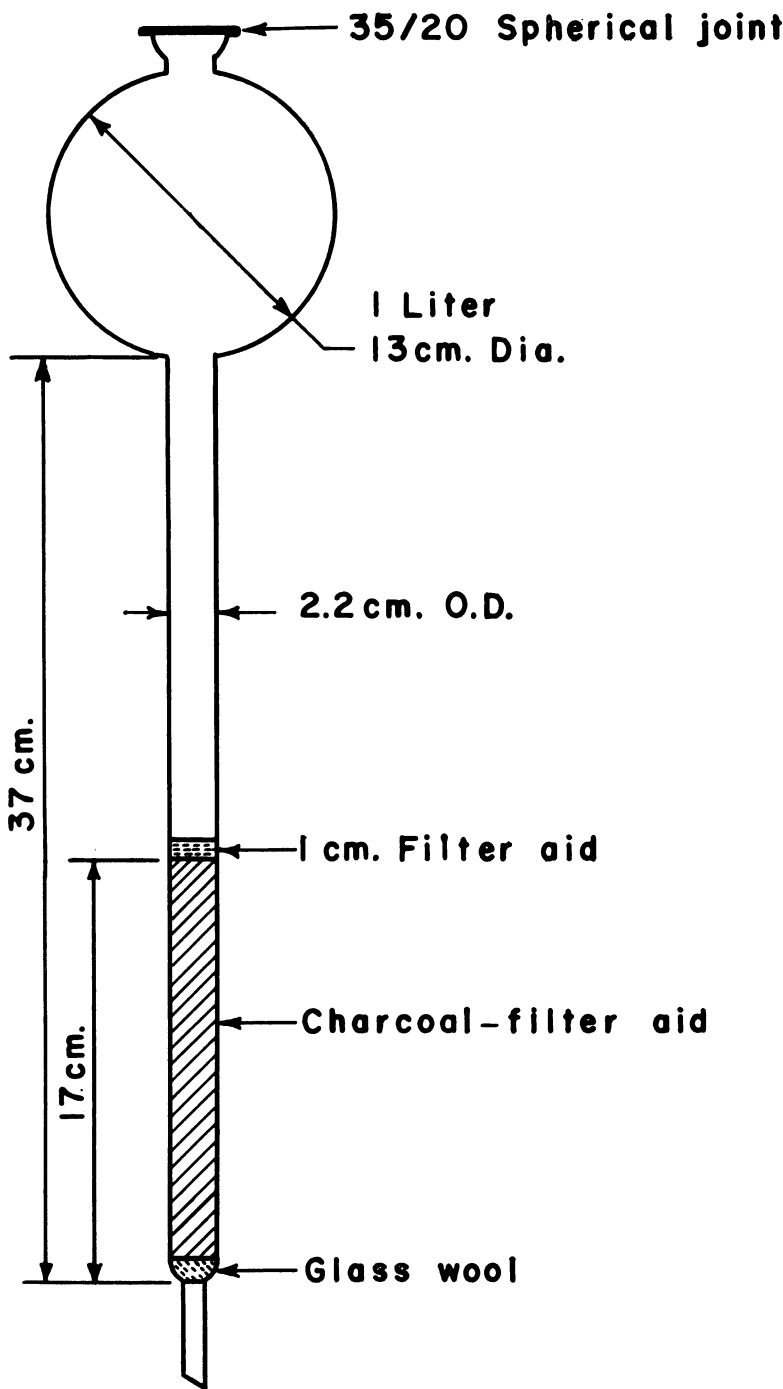


FIGURE 8.—Analytical charcoal column used for honey analysis.

PREPARATION AND STANDARDIZATION OF ADSORPTION COLUMN.—Column, shown in figure 8, is 22 mm. outside diameter by 370 mm. long, with 1 liter spherical section and 35/20 spherical ground joint at top. Adsorbent is 1+1 mixture of Darco G-60 charcoal and rapid filter-aid (Celite 545 or Dicalite 4200).¹⁰

Insert glass wool plug, wet from below, and add enough dry adsorbent to the dry tube (23–26 cm.) to compress to 17 cm. when vacuum is applied with *gentle* tapping of column. Remove excess charcoal from walls of column, and add filter-aid layer at top with *gentle* packing (1–1.5 cm.). Wash column with 500 ml. H₂O and 250 ml. 50 percent EtOH, and let stand overnight with 50 percent EtOH on it. Flow rate should be 5.5–8.0 ml./min. with H₂O at 9 lb./sq. in. air pressure. Slower flow rates delay analyses excessively.

The following alternative wet packing procedure has been found to increase column flow rate: Prepare a column with glass wool plug and 10 mm. of dry filter aid at bottom. Then, with outlet open, add a suspension of 18 gm. of adsorbent mixture in 200 ml. of water. After 5 min., apply 4 lb./sq. in. air pressure until the charcoal surface is stabilized. After application of 9 lb./sq. in. pressure, use suction to remove any excessive charcoal mixture beyond 17 cm. depth and place layer of filter aid on the charcoal surface. Then continue washing as above.

Alcohol content of eluting solutions must be adjusted to retentive power of charcoal used. Wash column EtOH-free with 250 ml. H₂O, quantitatively add 10 ml. solution of 1.000 g. anhydrous dextrose to top, and draw it into column with suction; do not let dry. Add 300 ml. H₂O to top, break suction, apply pressure (10 lb./sq. in. max.), and collect eluate in five 50 ml. portions in tared beakers. Include 10 ml. from sample introduction in first 50 ml. fraction. Evaporate fractions on steam bath, dry in vacuum oven at 89°–100° C., and weigh.

Decant remaining H₂O from top of column, pass 50 ml. 5 percent EtOH and then 250 ml. H₂O through column, and repeat chromatography, using 1.000 g. anhydrous dextrose in 10 ml. 1 percent EtOH, washing with 250 ml. 1 percent EtOH as above. Repeat chromatography with 2 percent EtOH if necessary to select as solvent A that which removes dextrose in 150 ml.

Wash column with 250 ml. H₂O and then 20 ml. 5 percent EtOH. To top, add 10 ml. 5 percent EtOH solution containing 100 mg. maltose and 100 mg. sucrose. Elute as above with 250 ml. 5 percent EtOH, weighing evaporated 50 ml. portions of filtrate. Repeat, if necessary, with 7, 8, and 9 percent EtOH to find solvent B that will elute at least 98 percent disaccharides in 200 ml. Solvent A previously selected must not elute disaccharides. Combinations found satisfactory with various charcoals are 1, 7; 2, 8; 2, 9 percent. At conclusion, pass 100 ml. 50 percent EtOH through column, and store under layer of this solvent.

PREPARATION OF FRACTIONS.—Wash column with 250 ml. H₂O and

¹⁰ Darco G-60 is a product of Darco Corporation, New York, N.Y.; Celite 545, Johns Manville, New York, N.Y.; and Dicalite 4200, Dicalite Div., Great Lakes Carbon Corp., New York, N.Y. Mention of trade names does not imply endorsement by the Department of Agriculture over similar products not mentioned.

decant any supernatant. Pass 20 ml. solvent A through column, and discard. Dissolve 1 g. sample in 10 ml. solvent A in 50 ml. beaker. Transfer sample (using long-stem funnel) onto column, and force into column. Use 15 ml. solvent A to rinse beaker and funnel, and add to column. Collect all eluate, beginning with sample introduction in 250 ml. volumetric flask. Add 250 ml. solvent A, and collect exactly 250 ml. total (fraction A-monosaccharides). Decant excess solvent from top, add 265–270 ml. solvent B, and collect 250 ml. in volumetric flask (fraction B-disaccharides). Decant excess, add 110 ml. 50 percent EtOH (solvent C), and collect 100 ml. in volumetric flask (fraction C-higher sugars). Mix each fraction thoroughly. Column may be stored indefinitely, outlet closed, under 50 percent EtOH. Discard packing after 8 uses.

LEVULOSE DETERMINATION, REAGENTS.—(a) *Iodine solution*.—0.05 N. Dissolve 13.5 g. pure I in solution of 24 g. KI in 200 ml. H₂O, and dilute to 2 liters. Do not standardize.

(b) *Sodium hydroxide solution*.—0.1N. Dissolve 20 g. NaOH and dilute to 5 liters.

(c) *Sodium hydroxide solution*.—1N. Dissolve 41 g. NaOH in H₂O and dilute to 1 liter.

(d) *Sulfuric acid solution*.—1N. Add 56 ml. H₂SO₄ to H₂O and dilute to 2 liters.

(e) *Sulfuric acid solution*.—2N. Add 56 ml. H₂SO₄ to H₂O and dilute to 1 liter.

(f) *Sodium sulfite solution*.—1%. Dissolve 1 g. Na₂SO₃ in 100 ml. H₂O. Make fresh daily.

(g) *Starch solution*.—1%, freshly prepared.

(h) *Bromocresol green solution*. Dissolve 150 mg. bromocresol green in 100 ml. H₂O.

(i) *Shaffer-Somogyi reagent*. Dissolve 25 g. each anhydrous Na₂CO₃ and Rochelle salt in about 500 ml. H₂O in 2-liter beaker. Add 75 ml. of solution of 100 g. CuSO₄·5H₂O per liter, through funnel with tip under surface, with stirring. Add 20 g. dry NaHCO₃, dissolve, and add 5 g. KI. Transfer solution to 1-liter volumetric flask, add 250 ml. 0.100N KIO₃ (3.567 g. dissolved and diluted to 1 liter), dilute to volume, and filter through fritted glass. Age overnight before use.

(j) *Iodide-oxalate solution*. Dissolve 2.5 g. KI and 2.5 g. K oxalate in 100 ml. H₂O. Make fresh weekly.

(k) *Sodium thiosulfate standard solution*.—0.005N. Prepare from standardized stock 0.1000N solution. Make fresh daily.

LEVULOSE DETERMINATION, PROCEDURE.—Pipet 20 ml. fraction A into 200 ml. volumetric flask. Add 40 ml. 0.05N I solution by pipet, then with vigorous mixing add 25 ml. 0.1N NaOH over 30 seconds period, and immediately place flask in 18±0.1°C. water bath. Exactly 10 minutes after alkali addition, add 5 ml. 1N H₂SO₄ and remove from bath. Exactly neutralize I with Na₂SO₃ solution, using 2 drops starch solution near end point. Back-titrate with dilute I if necessary. Add 5 drops bromocresol green and exactly neutralize solution with 1N NaOH; then make just acid to indicator. Dilute to volume and

determine reducing value of 5 ml. aliquots by Shaffer-Somogyi method: Place 5 ml. in 25 by 200 mm. test tubes, add 5 ml. Shaffer-Somogyi reagent, and mix by swirling. Place in boiling H₂O bath and cap with funnel or bulb. After 15 minutes, remove to running H₂O cooling bath with care, and cool 4 minutes. Carefully remove caps, and add, down side, 2 ml. iodide-oxalate solution and then 3 ml. 2N H₂SO₄. (Do not agitate solution while alkaline.) Mix thoroughly, seeing that all Cu₂O is dissolved. Return to cold H₂O and let stand 5 minutes, mixing twice in this period. Titrate in tube with 0.005N Na₂S₂O₃ and starch indicator. (Magnetic stirrer is most suitable for purpose.) Make duplicate blanks and determinations. Deduct titration from that of blank and calculate levulose:

$$\text{Percent levulose} = \frac{500 [(\text{titer} \times 0.1150) + 0.0915] \times 100}{\text{mg. sample}}$$

Levulose correction for dextrose determination = l.c. = $[(\text{titer} \times 0.1150) + 0.0915] \times 40$. Bracketed quantity is mg. levulose in 5 ml. aliquot, valid between 0.5 and 1.75 mg. levulose.

DEXTROSE DETERMINATION, REAGENTS.—*Sodium thiosulfate solution*.—0.05N. Prepare from standardized stock 0.1000N solution.

DEXTROSE DETERMINATION, PROCEDURE.—Pipet 20 ml. fraction A into duplicate 250 ml. Erlenmeyers. Evaporate to dryness on steam bath in air current. Add 20 ml. H₂O, pipet 20 ml. 0.05N I, and as in levulose determination, add 25 ml. 0.1N NaOH slowly, and immediately place in $18 \pm 0.1^\circ$ H₂O bath. Exactly 10 minutes from end of alkali addition, add 5 ml. 2N H₂SO₄, remove from bath, and titrate with 0.05N Na₂S₂O₃, using starch solution. Make duplicate blanks, using H₂O. Subtract titration value from that of blank, and calculate dextrose:

$$\text{Percent dextrose} = \frac{56.275 [\text{titer} - (0.01215 \times \text{l.c.})] \times 100}{\text{mg. sample}},$$

where l.c. = levulose correction from levulose determination. Equation is valid over range 10–50 mg. dextrose in 20 ml. In presence of dextrose, 1 mg. levulose requires 0.01215 ml. 0.05N Na₂S₂O₃, in range 15–60 mg. levulose.

REDUCING DISACCHARIDES AS MALTOSE, DETERMINATION.—Pipet duplicate 5 ml. aliquots of fraction B into 25 × 200 mm. test tubes, and add 5 ml. Shaffer-Somogyi reagent. Determine reducing value as in levulose determination, except boil tubes 30 minutes. Value for 15 minute-water blank may be used here. Calculate % reducing disaccharides as maltose:

$$\text{Percent "maltose"} = \frac{50 [(\text{titer} \times 0.2264) + 0.075] \times 100}{\text{mg. sample}}$$

Maltose correction for sucrose determination = maltose titer × 0.92. Reducing value of maltose at 15 minutes is 92 percent of final

value. Bracketed quantity is mg. maltose in 5 ml. aliquot, valid between 0.15 to 3.80 mg. maltose.

SUCROSE DETERMINATION, REAGENTS.—(a) *Hydrochloric acid solution*.—6N. Add 250 ml. HCl to H₂O and dilute to 500 ml.

(b) *Sodium hydroxide solution*.—5N. Dissolve 103 g. NaOH in H₂O and dilute, after cooling, to 500 ml.

SUCROSE DETERMINATION, PROCEDURE.—Pipet 25 ml. fraction B into 50 ml. volumetric flask. Add 5 ml. 6N HCl and 5 ml. H₂O. Mix, let stand in 60° H₂O bath 17 minutes, cool, and neutralize to bromeresol green with 5N NaOH (polyethylene squeeze bottle is excellent for holding and delivering alkali). Adjust to acid color of indicator, using 2N H₂SO₄ to correct overrun. Dilute to volume and determine reducing value of 5 ml. aliquots by Shaffer-Somogyi determination as for levulose. Subtract titration from blank, and calculate sucrose by reference to curve constructed from following table:

Sucrose in 5 ml. aliquot oxidized, mg.	0.005 N Na ₂ S ₂ O ₃ required, ml.
0. 255	1. 75
. 502	3. 95
1. 004	8. 72
1. 260	11. 28

From curve obtain S_1 = sucrose equivalent to maltose correction (see above for maltose) and S_2 = sucrose equivalent of sucrose titer.

$$\text{Percent sucrose} = \frac{50 (2S_2 - S_1) \times 100}{\text{mg. sample}}$$

MELEZITOSE DETERMINATION, REAGENTS.—(a) *Yeast invertase*.—1 percent. Dissolve 1 g. melibiase-free yeast invertase preparation in water and dilute to 100 ml.

(b) *Buffer*.—M/10 acetate, pH 4.5. Dissolve 6 g. glacial acetic acid in 500 ml. water, titrate with N NaOH to pH 4.5, dilute to 1 liter.

MELEZITOSE DETERMINATION, PROCEDURE.—To 25 ml. of fraction B in a 50 ml. volumetric flask add 0.1 ml. enzyme solution and 1.0 ml. buffer. Mix, let stand 1 hour at room temperature, make to volume and determine reducing value of 5 ml. aliquot by Shaffer-Somogyi determination as for levulose. Subtract titration value from blank (with enzyme, buffer) and obtain value for true sucrose from table given under "sucrose." Calculate as for sucrose.

The difference between this value and that obtained as described under "sucrose" is considered due to melezitose. Multiply the difference, expressed as percent of honey sample, by 1.47 to obtain estimation of melezitose content of honey sample.

NOTE.—The amount of enzyme solution used will depend on the strength of the invertase solution used.

HIGHER SUGARS, OR "DEXTRIN", PROCEDURE.—Pipet 25 ml. aliquots of fraction C into 50 ml. volumetric flasks. Add 5 ml. 6N HCl and 5 ml. H₂O, and heat in boiling H₂O bath 45 minutes. Cool, neutralize as for sucrose, dilute to volume, and determine reducing value by Shaffer-Somogyi determination as for levulose. Subtract titration

value from blank and obtain dextrose equivalent from curve constructed from data below:

<i>Dextrose, mg.</i>	<i>Titer, ml.</i>
0.05	0.20
.10	.60
.25	1.85
.50	4.00
1.00	8.50
2.00	17.60

$$\text{Percent higher sugars} = \frac{40 \text{ (dextrose equiv.)} \times 100}{\text{mg. sample}}$$

NOTES.—For most accurate work, Shaffer-Somogyi values must check within 0.04 ml. Calibration of entire procedures, including column, using known synthetic mixtures of dextrose, levulose, sucrose, maltose, and raffinose (corrected for moisture) is recommended for critical work. Efficiency of column separation may be checked by paper chromatography of fractions A, B, and C.

Free, Total and Lactone Acidity

The following titration is carried out with a pH meter (recently calibrated at pH 4 and 8) and 10-ml. microburets with extended tips delivering 0.05N HCl and 0.05N alkali into the beaker used to contain the sample:

To a 10-g. sample of honey contained in a 250-ml. beaker, add 75 ml. CO₂-free distilled water. Dissolve honey and stir the solution with a magnetic stirrer. Place the electrodes of a pH meter in the solution and record the initial pH. Then titrate the solution with 0.05N NaOH. Add the NaOH at a rate so that individual drops just tend to merge into a steady stream (5.0 ml./min.). Stop adding NaOH when the pH reaches 8.5. Immediately add 10 ml. 0.05N NaOH by means of a 10-ml. pipet and without delay titrate back to pH 8.3 by adding 0.05N HCl from a 10-ml. buret.

The amount of NaOH added from the buret, minus the "blank" correction, is considered the measure of the free acid present, and the amount of HCl used subtracted from 10 ml. is a measure of the lactone content. The sum of free acid and lactone is the total acidity. All values are calculated to milliequivalents per kilogram. The titration rate given is as rapid as found consistent with acceptable reproducibility. Titration to pH 8.5 is equivalent to maintenance of phenolphthalein pink for 10 seconds, since the pH falls to 8.3 in that time.

Ash

Weigh 5–10 g. honey into a flamed and weighed platinum dish. Place under a 375-watt infrared lamp with variable voltage input and slowly increase until sample is black and dry and there is no longer

any danger of loss by foaming. Place in a muffle furnace at 600° C. overnight. Cool and weigh.

$$\frac{\text{wt. ash}}{\text{wt. sample}} \times 100 = \text{percent ash}$$

Nitrogen

REAGENTS.—(a) *Methyl red-methylene blue indicator*.—Mix 2 parts 0.2 percent alcoholic methyl red solution with 1 part 0.2 percent alcoholic methylene blue solution.

(b) *Sodium hydroxide-sodium thiosulfate*.—Add 25 ml. of 25 percent $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ to 100 ml. of 50 percent NaOH.

(c) *Boric acid*.—Saturated solution.

(d) *Hydrochloric acid*.—0.01 N, diluted from standard 0.1 N.

APPARATUS.—(a) *Digestion rack*.—Use rack with electric heaters which will supply sufficient heat to a 30 ml. flask to cause 15 ml. water at 25° C. to come to a rolling boil in not less than 2 or more than 3 minutes.

(b) *Distillation apparatus*.—Use one-piece distillation apparatus (40).

(c) *Digestion flasks*.—Use 30 ml. regular Kjeldahl flasks (40).

PROCEDURE.—Transfer 300 mg. honey (sample which will require 3–10 ml. 0.01N HCl) to 30 ml. Kjeldahl flask. Add 1.9 ± 0.1 g. K_2SO_4 , 40 ± 10 mg. HgO and 3.0 ± 0.1 ml. H_2SO_4 . Add boiling chips which pass No. 10 sieve and digest for 1 hour after acid comes to a true boil. Cool, add minimum quantity H_2O to dissolve solids, cool, place thin film of petroleum jelly on rim of flask. Transfer digest and boiling chips to distillation apparatus and check completeness of transfer by adding drop of indicator to final rinses. Place 125 ml. Phillips beaker or Erlenmeyer flask containing 2.5 ml. H_3BO_3 , 1–2 drops indicator under condenser with tip extending below surface. Add 8–10 ml. NaOH- $\text{Na}_2\text{S}_2\text{O}_3$ to still, collect about 15 ml. distillate, and dilute to approximately 25 ml. Titrate to gray end point or first appearance of violet. Make blank determination and calculate.

$$\text{Percent N} = \frac{(\text{ml. HCl-blank}) \times \text{N} \times 14.008 \times 100}{\text{wt. sample in mg.}}$$

Diastase

Buffered soluble starch-honey solution is incubated and time required to reach specified end point is determined by photoelectric photometer. Results are expressed as ml. 1 percent starch hydrolyzed by enzyme in 1 g. honey in 1 hour.

REAGENTS.—(a) *Iodine stock solution*.—Dissolve 8.80 g. resublimed I_2 in 30–40 ml. H_2O containing 22.0 g. KI, and dilute to 1 liter with H_2O .

(b) *Iodine solution*.—0.0007 N. Dissolve 20 g. KI and 5.00 ml. I solution, (a), in H_2O and dilute to 500 ml. Make fresh every second day.

(c) *Acetate buffer*.—pH 5.3 (1.59 M). Dissolve 87 g. NaOAc·3H₂O in 400 ml. H₂O, add about 10.5 ml. HOAc in H₂O, and dilute to 500 ml. Adjust pH to 5.30 with NaOAc or HOAc, if necessary.

(d) *Sodium chloride solution*.—0.5 M. Dissolve 14.5 g. NaCl in H₂O and dilute to 500 ml.

(e) *Starch solution*.—Weigh 2.000 g. soluble starch (Pfanstiehl, reagent grade, Improved Lintner Method or equivalent) and mix with 90 ml. H₂O in 250-ml. Erlenmeyer flask. Rapidly bring to boil, swirling solution as much as possible. Boil gently 3 minutes, cover, and let cool to room temperature. Transfer to 100 ml. volumetric flask and dilute to volume. Observe procedure closely to limit variation in blank starch-I absorbance values.

APPARATUS—(a) *Reaction vessel*.—Attach side-arm, 18 × 60 mm., to 18 × 175 mm. test tube. Lower side of side-arm is attached 100 mm. from bottom of tube, making 45° angle with lower portion of tube.

(b) *Photoelectric colorimeter*.—Equipped with 660 mμ red filter, or 600 mμ interference filter.

STANDARDIZATION.—Pipet 5 ml. starch solution into 10 ml. H₂O and mix well. Pipet 1 ml. of this solution into several 50 ml. graduated cylinders containing 10 ml. of the dilute I solution. Mix well, and determine H₂O dilution necessary to produce absorbance value of 0.760 ± 0.02 in photometer-test tube (or cell) combination to be used. This is standard dilution for starch preparation used. Repeat when changing starch source.

PROCEDURE.—Weigh 5 g. sample into 20 ml. beaker, dissolve in 10–15 ml. H₂O and 2.5 ml. buffer solution, and transfer to 25 ml. volumetric flask containing 1.5 ml. NaCl solution. Dilute to volume. (Solution must be buffered before adding to NaCl solution.)

Pipet 5 ml. starch solution into side arm of reaction tube and 10 ml. sample solution into bottom of tube, with care not to mix. Place tube in H₂O bath 15 minutes at $40 \pm 0.2^\circ$ C.; then mix contents by tilting tube back and forth several times. Start stopwatch. At 5 minutes, remove 1 ml. aliquot with pipet and add rapidly to 10.00 ml. dilute I solution in 50 ml. graduated cylinder. Mix, dilute to previously determined volume, and determine absorbance in photoelectric photometer. Note time from mixing of starch and honey to addition of aliquot to I as reaction time. (Place 1 ml. pipet in reaction tube for reuse when later aliquots are taken.) Continue taking 1 ml. aliquots at intervals until absorbance value of <0.235 is obtained.

The 5 minute value gives an approximation of end point as follows:

Absorbance	End Point (min.)
0.7	>25
.65	20–25
.6	15–18
.55	11–13
.5	9–10
.45	7–8

Plot absorbance versus time on rectilinear paper; draw straight line through starting absorbance and as many points as possible. From graph, determine time diluted reaction-I mixture reaches absorbance of 0.235. Divide 300 by this time to obtain diastase number.

ACCURACY OF SUGAR ANALYSES BY THE SELECTIVE ADSORPTION METHOD

In developing the method (54), known sugar mixtures were subjected to the procedure and recoveries calculated. Additions of known sugars to honey solutions were satisfactorily accounted for.

During the work described in this bulletin, opportunities were taken to obtain measures of the accuracy of the method. Aliquots of the three analytical fractions for each of 17 consecutive samples were evaporated, and the dry weight so obtained was compared with that calculated from the sugar analyses. The results demonstrate the general accuracy of the method and also give some information on the materials not analyzed by the procedure.

As an additional check on the accuracy of the method as applied to honey, monosaccharide fractions from the routine analyses of five honey samples were analyzed for dextrose and levulose polarimetrically as well as by the chemical procedure. While it has been shown (57) that polarimetric determination of levulose in honey is not accurate, the use of charcoal column pretreatment removes interfering sugars and other materials and provides a solution containing only dextrose and levulose which can be analyzed polarimetrically.

In the analytical procedure, the carbohydrates of a honey sample (0.8–1.0 g.) are obtained as follows:

Fraction A—250 ml.—dextrose, levulose

Fraction B—250 ml.—sucrose, reducing disaccharides

Fraction C—100 ml.—higher sugars

The dextrose and levulose are determined individually. Reducing disaccharides are determined in fraction B without preliminary hydrolysis and calculated as maltose; sucrose is determined by increase in reducing power after a mild acid hydrolysis. In fraction C, reducing sugars after hydrolysis are determined by copper reduction and reported as dextrose.

Fifty-ml. aliquots of each of these three fractions from 17 consecutive honey samples were evaporated to dryness in a current of air in a steam bath and the weights of the residues determined. All solutions and residues were colorless.

Table 20 shows the weights so obtained for 4 typical samples of the 17 together with the weight calculated to be present from the chemical analyses. An analysis of variance on the individual weights of the three fractions from the 17 samples (the 4 in table 20 plus 13 not shown) as found by weighing and as calculated from the analytical values gave the results shown in table 21. The difference in the results given for fraction A by the two methods is not significant; the amount of unanalyzed material in fraction B is highly significant, and that for fraction C is also highly significant.

Table 22 shows (for the same samples as in table 20) the amount of material found in the fractions by evaporation and that calculated from the analyses, both calculated for the entire sample. The last line (not analyzed) is the material not accounted for by each procedure. About 2.3 percent of honey material (17-sample average) in the three analytical fractions escapes analysis by the selective adsorption procedure. Table 23 gives the distribution of this material among

TABLE 20.—*Weight of material in 50 ml. aliquots of analytical fractions for 4 samples*

Fraction	Sample A		Sample B		Sample C		Sample D	
	Found	Calculated	Found	Calculated	Found	Calculated	Found	Calculated
Monosaccharide.....	Mg. 140.3	Mg. 138.9	Mg. 136.8	Mg. 137.6	Mg. 135.0	Mg. 134.7	Mg. 132.1	Mg. 132.2
Disaccharide.....	18.9	14.2	23.4	19.6	20.8	17.3	17.6	15.9
Higher sugars.....	7.0	5.6	10.0	8.2	9.7	6.9	10.5	8.0

TABLE 21.—*Analysis of variance for 17 samples*¹

Source of variation	D.F.	Monosaccharides			Disaccharides			Higher sugars		
		S.S.	M.S.	F	S.S.	M.S.	F	S.S.	M.S.	F
Total.....	33	1212.28			236.4			349.9		
Materials.....	16	896.8	56.0	2.89	163.1	10.2	11.2**	328.1	20.5	25.7**
Methods.....	1	2.18	2.18	.11	58.8	58.8	64.9**	54.1	54.1	67.7**
Error.....	16	313.3	19.6		14.5	.91		12.8	.80	

¹ 4 samples in table 20 and 13 additional.

**Significant at 1-percent probability level.

TABLE 22.—*Material in analytical fractions, determined by 2 methods, whole-sample basis*

Fraction	Sample A		Sample B		Sample C		Sample D		Average 17 samples	
	By weight	By analyses	By weight	By analyses	By weight	By analyses	By weight	By analyses	By weight	By analyses
Monosaccharide.....	<i>Percent</i> 71.37	<i>Percent</i> 70.67	<i>Percent</i> 69.68	<i>Percent</i> 70.12	<i>Percent</i> 67.82	<i>Percent</i> 67.70	<i>Percent</i> 69.97	<i>Percent</i> 70.03	<i>Percent</i> 71.23	<i>Percent</i> 71.06
Disaccharide.....	9.61	7.22	11.92	9.99	10.45	8.60	9.32	8.40	9.12	7.73
Higher sugars.....	1.62	1.15	2.16	1.68	1.95	1.38	2.22	1.70	2.18	1.22
Total sugars.....	82.60	79.04	83.76	81.79	80.22	77.68	81.51	80.13	82.53	80.01
H ₂ O ¹	15.7	15.7	15.8	15.8	18.2	18.2	18.0	18.0	17.3	17.3
Total.....	98.3	94.7	99.6	97.6	98.4	95.9	99.5	98.1	99.8	97.3
Not analyzed ²	1.7	5.3	.4	2.4	1.6	4.1	.5	1.9	.2	2.7

¹ Moisture content of honey sample.² 100—total.

TABLE 23.—*Distribution of unanalyzed material, whole-sample basis*¹

Fraction	Sample				Average, 17 samples
	A	B	C	D	
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Monosaccharide.....	0. 70	—0. 44	0. 12	—0. 06	0. 40
Disaccharide.....	2. 39	1. 93	1. 85	. 98	1. 40
Higher sugars.....	. 47	. 48	. 57	. 52	. 52
Total.....	3. 56	1. 97	2. 54	1. 44	2. 32

¹ Values show amount of unanalyzed material in each fraction, as percent of the entire sample.

the three fractions. The largest part of the material is in fraction B, the disaccharides.

For the polarimetric determination of the sugars of fraction A, 100 ml. aliquots of fraction A from five successive honey analyses were evaporated as before. They were made to 10.00 ml. with water and a little ammonia and their rotation was determined. The specific rotation was calculated using the evaporated weights; and from the known values for pure levulose and dextrose, the composition of the solution was calculated. An example follows:

Sample E (table 24). Original weight..... 0.9958 g.
 Residue from 100 ml. fraction A..... 0.2806 g.
 Angular rotation (2 dm.)..... —1.55°

$$[\alpha]_D^{20} = -27.62^\circ$$

$[\alpha]_D^{20}$ levulose = —92.5°; dextrose, = 52.5 percent

$$\frac{-92.5 - (-27.62)}{-92.5 - (52.5)} = \frac{-64.88}{-145.0} = 44.74 \text{ percent dextrose}$$

$0.2806 \times 0.4474 = 0.1255$ g. dextrose
 $0.2806 \times (1 - 0.4474) = 0.1550$ g. levulose

$$\frac{0.1255 \times 2.5 \times 100}{0.9958} = 31.51 \text{ percent dextrose}$$

$$\frac{0.1550 \times 2.5 \times 100}{0.9958} = 38.91 \text{ percent levulose}$$

Found by selective adsorption method,
 30.79 percent dextrose,
 39.15 percent levulose.

Table 24 shows the values obtained for the five samples. It also shows an analysis of variance of these data. The variance is almost entirely due to materials (different honey samples); that due to the methods is not significant at the 5-percent level for either dextrose or levulose. ($F = 6.4$ and 0.33 ; critical values at the 5-percent level = 6.39 for materials and 7.71 for methods.)

The agreement between the values obtained by weighing and by

TABLE 24.—*Determination of dextrose and levulose in monosaccharide fractions by 2 methods*

Sample	Dextrose		Levulose	
	Chemical	Polarimetric	Chemical	Polarimetric
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
E.....	30.79	31.51	39.15	38.91
F.....	33.57	34.57	37.55	36.55
G.....	33.15	33.87	38.82	38.40
H.....	29.47	30.22	38.69	39.77
I.....	33.52	33.21	38.65	38.24
Average.....	32.10	32.68	38.57	38.38

Analysis of variance

Source of variance	D.F.	Dextrose			Levulose		
		S.S.	M.S.	F	S.S.	M.S.	F
Total.....	9	27.43			7.15		
Materials.....	4	26.08	6.52	48.5**	5.87	1.47	4.90
Methods.....	1	.83	.83	6.4	.10	.10	.33
Error.....	4	.52	.13		1.19	.30	

**Significant at 1-percent probability level. $F_{0.05}=6.39$ for materials; 7.71 for methods.

calculation from the dextrose and levulose values in the monosaccharide fraction is satisfactory. This fraction is the most important in honey, making up about 85 percent of the sugars. The 0.40 percent discrepancy found for the 17-sample average (table 23) may be compared with the standard deviation obtained when four honey samples were analyzed by three analysts in one laboratory (0.38 percent for dextrose, 0.42 percent for levulose) (50).

The method of analysis of fraction B is a compromise, since it has been found to contain maltose, isomaltose, turanose, maltulose, sucrose (51), and also kojibiose (47). Some evidence of trehalose (51) and leucrose (47) has been obtained. The relative reducing power of these sugars varies considerably; kojibiose is reported to have only about 6 percent of the reducing power of glucose toward the Shaffer-Hartman copper reagent (31). Trehalose, being nonreducing, would not be determined by the procedure used, but would appear in fraction B if present. It is therefore likely that the unanalyzed material in the disaccharide fraction is at least in part kojibiose. Table 23 shows that it varies from sample to sample. The unanalyzed material in fraction C averages 0.52 percent. Inspection of the 17 samples shows that it does not vary as widely as does that in fraction B. It may be

a systematic error in the determination, due to incomplete hydrolysis of higher sugars or destruction of fructose in the acid hydrolysis.

The satisfactory agreement found for dextrose and levulose values in the monosaccharide fraction by the two methods, plus the agreements between weighed and calculated residues, is evidence for the essential accuracy of the analytical procedure. An earlier study of five methods of honey analysis—made before the selective adsorption method was developed (57)—showed that variance due to methods was highly significant and greater than that due to differences among honey samples of different floral types. Here, table 24 shows that variance due to samples is about 10 times that due to methods in the analysis of monosaccharide fractions by two procedures (chemical and physical). Variance due to methods is not significant at the 5-percent level for either dextrose or levulose.

In conclusion, comparison of dry weights of fractions from the selective adsorption analysis of honey with values calculated from the analysis shows that about 2.3 percent of the material passing through the charcoal column is not analyzed. Most of this material is in the disaccharide fraction and probably represents kojibiose, possibly also trehalose. Polarimetric analyses of the monosaccharide fraction from the honey analyses gives results for dextrose and levulose not differing significantly from those obtained by chemical methods.

FLORAL SOURCE INDEX—COMMON NAMES, SYNONYMS, AND BOTANICAL NAMES

Most useful sources for the information in this list were Pellett (29), and Lovell (24). Oertel (27) was also consulted. As pointed out by these authors, identical plants may have different common (beekeeper's) names at different localities, and also the same name may refer to entirely different plants in different areas.

Acacia spp., see Catsclaw.

Acer negundo, see Honeydew, boxelder.

Actinomeris alternifolia, see Wing-stem.

	Sample No.
Alfalfa (<i>Medicago sativa</i>)-----	1-58, 102, 120, 130, 134, 135, 173, 198-208, 277- 284, 290, 318, 319.

Alfalfa honeydew, see Honeydew, alfalfa.

Alfalfa, wild, see Wild alfalfa.

Ampelopsis spp., see Peppervine.

Anaphalis margaritacea, see Pearly everlasting.

Antigonon leptopus, see Coralvine.

Arctostaphylos spp., see Manzanita.

Arrow-weed (<i>Pluchea sericea</i>)-----	186.
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Aster (<i>Aster</i> spp.)-----	59-66, 126, 285, 294, 339, 340, 348, 350.
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Astragalus haydenianus, see Vetch, milk.

Athel tree (<i>Tamarix aphylla</i>)-----	67, 68.
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Avocado (<i>Persea americana</i>)-----	430.
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Bachelor button (<i>Centaurea cyanus</i>)-----	485.
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Bamboo, Japanese (<i>Polygonum sachalinense</i>)-----	69.
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Barbarea vulgaris, see Winter cress.

Basswood (<i>Tilia americana</i>)-----	70-78, 120, 209, 210, 277, 286-290, 303, 455.
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Bean, lima (<i>Phaseolus limensis</i>)-----	79-81.
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Bean, pea (<i>Phaseolus vulgaris</i>)-----	82.
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Bearberry, see Manzanita.

Beard-tongue, see Pentstemon.	
<i>Berchemia scandens</i> , see Rattan.	
Bergamot (<i>Monarda fistulosa</i>)	83.
<i>Bidens</i> spp., see Spanish needle.	
Birdsfoot trefoil, see Trefoil, birdsfoot.	
Blackberry (<i>Rubus</i> spp.)	84-88, 249, 328, 485.
Black locust, see Locust, black.	
Black willow, see Willow, black.	
Blueberry (<i>Vaccinium</i> spp.)	147, 148.
Blue curls (<i>Trichostema lanceolatum</i>)	130, 149.
Blue thistle, see Thistle, blue.	
Blue vervain, see Vervain, blue.	
Bluevine (<i>Gonolobus laevis</i>)	24, 150.
Boneset (<i>Eupatorium</i> spp.)	151.
Boxelder honeydew, see Honeydew, boxelder.	
<i>Brassica campestris</i> , see Mustard.	
Brown knapweed, see Knapweed, brown.	
Buckwheat (<i>Fagopyrum esculentum</i>)	152-157, 342.
Buckwheat, California, see Buckwheat, wild.	
Buckwheat, wild (<i>Eriogonum fasciculatum</i>)	158-162, 420.
Bugloss, see Thistle, blue.	
Cabbage palmetto, see Palmetto, cabbage.	
California buckwheat, see Buckwheat, wild.	
Canada thistle, see Thistle, Canada.	
Cantelope (<i>Cucumis melo</i>)	163.
Capevine (<i>Lippia nodiflora</i>)	164.
Capeweed, see Capevine.	
Carrot, wild (<i>Daucus carota</i>)	165.
<i>Carya juglandaceae</i> , see Honeydew, hickory.	
<i>Castanea pumila</i> , see Chinquapin.	
Catmint, see Catnip.	
Catnip (<i>Nepeta cataria</i>)	73, 350.
Catsclaw (<i>Acacia</i> spp.)	422.
<i>Ceanothus velutinus</i> , see Snowbrush.	
Cedar honeydew, see Honeydew, cedar.	
<i>Centauria cyanus</i> , see Bachelor button.	
<i>Centauria nigra radiata</i> , see Knapweed, brown.	
<i>Centauria repens</i> , see Knapweed, Russian.	
<i>Centauria solstitialis</i> , see Thistle, star.	
Cherry (<i>Prunus cerasus</i>)	99.
Cherry, wild (<i>Prunus serotina</i>)	166.
Chickweed (<i>Stellaria media</i>)	122, 123.
Chinese tallow tree, see Tallow tree.	
Chinquapin (<i>Castanea pumila</i>)	167-169.
<i>Cirsium arvense</i> , see Thistle, Canada.	
<i>Citrus paradisi</i> , see Grapefruit.	
<i>Citrus sinensis</i> , see Orange.	
Clethra, see Pepperbush.	
<i>Clethra alnifolia</i> , see Pepperbush.	
<i>Cliftonia monophylla</i> , see Titi, spring.	
Clover (unspecified) (<i>Trifolium</i> spp.)	25, 26, 74-77, 119, 120, 124, 165, 216, 247, 248, 251- 305, 341, 348, 358, 427, 435, 439, 450, 456, 457, 460.
Clover, alsike (<i>Trifolium hybridum</i>)	25, 134, 170-175, 216, 228, 242, 248, 267, 268, 282, 283, 285, 303.
Clover, crimson (<i>Trifolium incarnatum</i>)	176-182, 247, 272.
Clover, deer, see Wild alfalfa.	
Clover, Dutch, see Clover, white.	
Clover, hop (<i>Trifolium procumbens</i>)	181, 247.
Clover, hubam (<i>Melilotus alba</i> var. <i>annual</i>)	183-186.
Clover, ladino (<i>Trifolium repens latum</i>)	173, 216, 268, 294, 444.
Clover, Mexican, see Mexican clover.	
Clover, Persian (<i>Trifolium resupinatum</i>)	249.

	Sample No.
Clover, red (<i>Trifolium pratense</i>)-----	187, 247, 450.
Clover, strawberry (<i>Trifolium fragiferum</i>)-----	188.
Clover, sweet (<i>Melilotus</i> spp.)-----	25, 33-57, 78, 82, 102, 117, 118, 135, 174, 189-229, 248, 250, 267, 272, 282, 283, 285, 287, 288, 292, 450.
Clover, sweet, white (<i>Melilotus alba</i>)-----	216, 221-229, 299.
Clover, sweet, yellow (<i>Melilotus officinalis</i>)-----	58, 217-229, 288.
Clover, white (<i>Trifolium repens</i>)-----	25, 112, 118, 122, 123, 175, 188, 228-250, 267, 268, 272, 283, 285, 287, 292, 294, 299, 303, 363, 428, 434, 458.
Clover, white, Dutch, see Clover, white.	
Coralvine (<i>Antigonon leptotus</i>)-----	306, 307.
Cotton (<i>Gossypium hirsutum</i>)-----	27, 119, 244, 245, 293, 308- 319, 422.
Cranberry (<i>Vaccinium macrocarpon</i>)-----	320, 321.
Crotalaria (<i>Crotalaria striata</i>)-----	322.
<i>Crotalaria striata</i> , see Crotalaria.	
Crownbeard, see Wing-stem.	
<i>Crysothamnus nauseosus</i> , see Rabbitbrush.	
Cucumber (<i>Cucumis sativus</i>)-----	323.
<i>Cucumis melo</i> , see Cantelope.	
<i>Cucumis sativus</i> , see Cucumber.	
<i>Cyrilla parvifolia</i> , see Titi.	
Dandelion (<i>Taraxacum officinale</i>)-----	99, 134, 246, 487.
<i>Daucus carota</i> , see Carrot, wild.	
Deer clover, see Wild alfalfa.	
<i>Echium vulgare</i> , see Thistle, blue.	
<i>Epilobium angustifolium</i> , see Fireweed.	
<i>Eriogonum fasciculatum</i> , see Buckwheat, wild.	
Eucalyptus (<i>Eucalyptus</i> spp.)-----	324, 325.
<i>Eupatorium</i> spp., see Boneset.	
Everlasting, see Pearly everlasting.	
<i>Fagopyrum esculentum</i> , see Buckwheat.	
Fireweed (<i>Epilobium angustifolium</i>)-----	326-328.
French pink, see Bachelor button.	
<i>Gaillardia pulchella</i> , see Marigold.	
Gallberry (<i>Ilex glabra</i>)-----	125, 180, 329-335.
<i>Gaylussacia baccata</i> , see Huckleberry.	
Golden honey plant, see Wing-stem.	
Goldenrod (<i>Solidago</i> spp.)-----	28, 29, 65, 66, 82, 120, 126, 157, 294, 295, 336-343.
<i>Gonolobus laevis</i> , see Bluevine.	
<i>Gossypium hirsutum</i> , see Cotton.	
Grape, scuppernong (<i>Vitis rotundifolia</i>)-----	344.
Grapefruit (<i>Citrus paradisi</i>)-----	380-393.
<i>Grindelia squarrosa</i> , see Rosinweed.	
Gum, black (<i>Nyssa sylvatica</i>)-----	345.
Gum, sour, see Gum, black.	
Gumweed, see Rosinweed.	
Hairy vetch, see Vetch, hairy.	
Heartsease (<i>Polygonum</i> spp.)-----	81, 126, 228, 296, 346-350, 430, 431.
<i>Helianthus</i> spp., see Sunflower.	
<i>Hemizonia fasciculata</i> , see Tarweed.	
Hickory honeydew, see Honeydew, hickory.	
Holly (<i>Ilex opaca</i>)-----	335, 351-353.
Honeydew (unspecified)-----	30, 112, 211, 434, 445, 458, 503-505.
Honeydew, alfalfa (<i>Medicago sativa</i>)-----	492.
Honeydew, boxelder (<i>Acer negundo</i>)-----	120.

	Sample No.
Honeydew, cedar (<i>Libocedrus decurrens</i>)	493-495.
Honeydew, hickory (<i>Carya juglandaceae</i>)	496.
Honeydew, oak (<i>Quercus fagaceae</i>)	497-501.
Horsemint (<i>Monarda punctata</i>)	354, 355.
Huckleberry (<i>Gaylussacia baccata</i>)	148.
<i>Ilex glabra</i> , see Gallberry.	
<i>Ilex opaca</i> , see Holly.	
Japanese bamboo, see Bamboo, Japanese.	
Japanese knotweed, see Bamboo, Japanese.	
<i>Kalmia latifolia</i> , see Mountain laurel.	
Knapweed, brown (<i>Centaurea nigra radiata</i>)	356.
Knapweed, Russian (<i>Centaurea repens</i>)	357.
Knotweed, Japanese, see Bamboo, Japanese.	
Laurel, see Mountain laurel.	
Lespedeza, perennial (<i>Lespedeza sericea</i>)	359.
<i>Lespedeza sericea</i> , see Lespedeza, perennial.	
<i>Libocedrus decurrens</i> , see Honeydew, cedar.	
<i>Ligustrum</i> spp., see Privet.	
Lima bean, see Bean, lima.	
Linden, see Basswood.	
<i>Lippia nodiflora</i> , see Capevine.	
<i>Liriodendron tulipifera</i> , see Tulip tree.	
Locust, black (<i>Robinia pseudo-acacia</i>)	302, 360-363.
Loosestrife, see Purple loosestrife.	
<i>Lotus corniculatus</i> , see Trefoil, birdsfoot.	
<i>Lotus glaber</i> , see Wild alfalfa.	
<i>Lythrum salicaria</i> , see Purple loosestrife.	
Mallow (<i>Malva</i> spp.)	364.
<i>Malva</i> spp., see Mallow.	
Manzanita (<i>Arctostaphylos</i> spp.)	365, 366.
Marigold (<i>Gaillardia pulchella</i>)	297, 367.
Matchweed, see Capevine.	
Mat grass, see Capevine.	
<i>Medicago sativa</i> , see Alfalfa.	
<i>Melilotus</i> spp., see Clover, sweet.	
<i>Melilotus alba</i> , see Clover, sweet, white.	
<i>Melilotus alba</i> var. <i>annual</i> , see Clover, hubam.	
<i>Melilotus officinalis</i> see Clover, sweet, yellow.	
<i>Mentha</i> spp., see Mint.	
<i>Mentha piperita</i> , see Peppermint.	
<i>Mentha spicata</i> , see Spearmint.	
Mesquite (<i>Prosopis glandulosa</i>)	31, 119, 368-70.
Mexican clover (<i>Richardsonia scabra</i>)	371.
Milk vetch, see Vetch, milk.	
Mint (<i>Mentha</i> spp.)	372.
<i>Monarda fistulosa</i> , see Bergamot.	
<i>Monarda punctata</i> , see Horsemint.	
Mountain laurel (<i>Kalmia latifolia</i>)	373.
Mountain stickweed, see Wing-stem.	
Mustard (<i>Brassica campestris</i>)	220, 302, 374.
<i>Nepeta cataria</i> , see Catnip.	
<i>Nyssa sylvatica</i> , see Gum, black.	
<i>Nyssa ogeche</i> , see Tupelo.	
Oak honeydew, see Honeydew, oak.	
Oak, poison (<i>Rhus diversiloba</i>)	375, 376.
Orange (<i>Citrus sinensis</i>)	377-393.
<i>Oxydendrum arboreum</i> , see Sourwood.	
Palmetto (<i>Sabal</i> spp.)	125, 394.
Palmetto, cabbage (<i>Sabal palmetto</i>)	395, 396.
Palmetto, saw (<i>Serenoa serrulata</i>)	397, 398.
Pea bean, see Bean, pea.	
Peach (<i>Prunus persica</i>)	99.

	Sample No.
Pear (<i>Pyrus</i> spp.)-----	99.
Pearly everlasting (<i>Anaphalis margaritacea</i>)-----	328.
Pentstemon (<i>Pentstemon</i> spp.)-----	399.
Pepperbush (<i>Clethra alnifolia</i>)-----	400.
Peppermint (<i>Mentha piperita</i>)-----	401, 402.
Peppervine (<i>Ampelopsis</i> spp.)-----	403, 437.
Perennial lespedeza, see Lespedeza, perennial.	
<i>Persea americana</i> , see Avocado.	
<i>Phaseolus limensis</i> , see Bean, lima.	
<i>Phaseolus vulgaris</i> , see Bean, pea.	
<i>Pluchea sericea</i> , see Arrow-weed.	
Poison oak, see Oak, poison.	
<i>Polygonum</i> spp., see Heartsease.	
<i>Polygonum sachalinense</i> , see Bamboo, Japanese.	
Privet (<i>Ligustrum</i> spp.)-----	166, 298, 404, 405.
<i>Prosopis glandulosa</i> , see Mesquite.	
Prune (<i>Prunus</i> sp.)-----	406.
<i>Prunus</i> spp., see Prune.	
<i>Prunus cerasus</i> , see Cherry.	
<i>Prunus persica</i> , see Peach.	
<i>Prunus serotina</i> , see Cherry, wild.	
Purple loosestrife (<i>Lythrum salicaria</i>)-----	407, 409.
<i>Pyrus</i> spp., see Pear.	
<i>Quercus fagaceae</i> , see Honeydew, oak.	
Rabbitbrush (<i>Crysothamnus nauseosus</i>)-----	58.
Raspberry (<i>Rubus occidentalis</i>)-----	122, 123, 303, 343, 410-413.
Rattan, see <i>Berchemia scandens</i> .	
Rebel-weed, see Purple loosestrife.	
Rhododendron (<i>Rhododendron</i> spp.)-----	414.
<i>Rhus</i> spp., see Sumac.	
<i>Rhus diversiloba</i> , see Oak, poison.	
<i>Rhus typhina</i> see Sumac, staghorn.	
<i>Richardsonia scabra</i> , see Mexican clover.	
<i>Robinia pseudo-acacia</i> , see Locust, black.	
Rose (<i>Rosa</i> spp.)-----	99.
Rosinweed (<i>Grindelia squarrosa</i>)-----	415, 416.
<i>Rubus</i> spp., see Blackberry.	
<i>Rubus occidentalis</i> , see Raspberry.	
Russian knapweed, see Knapweed, Russian.	
<i>Sabal</i> spp., see Palmetto.	
<i>Sabal palmetto</i> , see Palmetto, cabbage.	
Sage (<i>Salvia</i> spp.)-----	417-420.
Sage, white (<i>Salvia apiana</i>)-----	421.
<i>Salix nigra</i> , see Willow, black.	
<i>Salvia</i> spp., see Sage.	
<i>Salvia apiana</i> , see Sage, white.	
<i>Sapium schiferum</i> , see Tallow tree.	
Salt cedar (<i>Tamarix gallica</i>)-----	186, 424.
Saw palmetto, see Palmetto, saw.	
<i>Serenoa serrulata</i> , see Palmetto, saw.	
Smartweed, see Heartsease.	
Snowbrush (<i>Ceanothus velutinus</i>)-----	423.
Snowvine, see Peppervine.	
<i>Solidago</i> spp., see Goldenrod.	
Sorrel tree, see Sourwood.	
Sour gum, see Gum, black.	
Sourwood (<i>Oxydendrum arboreum</i>)-----	299, 424-428.
Spanish needle (<i>Bidens</i> spp.)-----	125, 126, 429-431.
Spearmint (<i>Mentha spicata</i>)-----	432.
Spring titi, see Titi, spring.	
Star thistle, see Thistle, star.	
<i>Stellaria media</i> , see Chickweed.	

Stickweed, see Wing-stem.	
Strawflower, see Pearly everlasting.	
Sumac (<i>Rhus</i> spp.)	Sample No.
Sumac, staghorn, (<i>Rhus typhina</i>)	111, 112, 134, 428, 433, 434.
Sunflower (<i>Helianthus</i> spp.)	435.
Swamp willow, see Willow, black.	32, 436.
Tallowtree (<i>Sapium schiferum</i>)	437.
Tamarisk, see Athel tree, Salt cedar.	
<i>Tamarix aphylla</i> , see Athel tree.	
<i>Tamarix gallica</i> , see Salt cedar.	
<i>Taraxacum officinale</i> , see Dandelion.	
Tarweed (<i>Hemizonia fasciculata</i>)	130.
Thistle, blue (<i>Echium vulgare</i>)	243, 291, 292, 438, 439.
Thistle, Canada (<i>Cirsium arvense</i>)	135, 328.
Thistle, star (<i>Centaurea solstitialis</i>)	130, 440-445, 495, 502.
Thyme (<i>Thymus serpyllum</i>)	446.
<i>Thymus serpyllum</i> , see Thyme.	
<i>Tilia americana</i> , see Basswood.	
Titi (<i>Cyrilla parvifolia</i>)	447.
Titi, spring (<i>Cliftonia monophylla</i>)	448.
Trefoil, birdsfoot (<i>Lotus corniculatus</i>)	187, 304, 449, 450, 476.
<i>Trichostema lanceolatum</i> , see Blue curls.	
<i>Trifolium</i> spp., see Clover.	
<i>Trifolium fragiferum</i> , see Clover, strawberry.	
<i>Trifolium hybridum</i> , see Clover, alsike.	
<i>Trifolium incarnatum</i> , see Clover, crimson.	
<i>Trifolium pratense</i> , see Clover, red.	
<i>Trifolium procumbens</i> , see Clover, hop.	
<i>Trifolium repens latum</i> , see Clover, ladino.	
<i>Trifolium repens</i> , see Clover, white.	
<i>Trifolium resupinatum</i> , see Clover, Persian.	
Tulip poplar, see Tulip tree.	
Tulip tree (<i>Liriodendron tulipifera</i>)	87, 88, 111, 112, 134, 182, 363, 451-461.
Tupelo (<i>Nyssa ogeche</i>)	345, 462-467.
Unknown (blue)	468.
<i>Vaccinium</i> spp., see Blueberry.	
<i>Vaccinium macrocarpon</i> , see Cranberry.	
Verbena, see Vervain, blue.	
<i>Verbena hastata</i> , see Vervain, blue.	
<i>Verbesina alternifolia</i> , see Wing-stem.	
Vervain, blue (<i>Verbena hastata</i>)	211, 212.
Vetch (<i>Vicia</i> spp.)	180, 214, 244, 272, 305, 353, 460, 469-476.
Vetch, hairy (<i>Vicia villosa</i>)	477-486.
Vetch, milk (<i>Astragalus haydenianus</i>)	487.
<i>Vicia</i> spp., see Vetch.	
<i>Vicia villosa</i> , see Vetch, hairy.	
Vipers bugloss, see Thistle, blue.	
<i>Vitis rotundifolia</i> , see Grape, scuppernong.	
White alder, see Pepperbush.	
White sage, see Sage, white.	
White tupelo, see Tupelo.	
Wild alfalfa (<i>Lotus glaber</i>)	421.
Wild buckwheat, see Buckwheat, wild.	
Wild carrot, see Carrot, wild.	
Wild cherry, see Cherry, wild.	
Willow, black (<i>Salix nigra</i>)	249, 488, 489.
Wing-stem (<i>Actinomeris alternifolia</i>) (<i>Verbesina alternifolia</i>)	490.
Winter cress (<i>Barbarea vulgaris</i>)	491.
Yellow rocket, see Winter cress.	

SAMPLE LOCATION INDEX, BY STATES

<i>State</i>	<i>Sample No.</i>
Alabama	334.
Alaska	122, 123.
Arizona	12, 27, 31, 67, 308, 310, 313, 314, 364, 369, 370, 422.
Arkansas	115, 143, 181, 403, 431, 471, 489.
California	3-8, 10, 21, 23, 68, 79, 116, 130, 144, 149, 158-162, 168, 169, 186, 311, 312, 316, 318, 319, 324, 325, 366, 368, 377-379, 393, 406, 417-421, 423, 440-444, 469, 470, 473, 475, 492-495, 497, 499, 500, 502.
Colorado	14, 30, 35, 52, 53, 55, 58, 172, 285, 487.
Connecticut	253, 339, 433, 496.
Delaware	110.
Florida	69, 125, 151, 164, 167, 177, 235, 266, 322, 330, 380- 392, 394-398, 436, 447, 462-467, 498.
Georgia	84, 176, 178, 329, 331, 332, 371.
Hawaii	None.
Idaho	19, 33, 36, 135.
Illinois	126, 191, 215, 216, 222, 225, 227, 268, 348.
Indiana	66, 83, 175, 229, 267, 350, 360, 454.
Iowa	20, 51, 73, 194, 205, 209, 210, 226, 228, 265, 270, 286, 296, 301, 323, 372, 415.
Kansas	1, 221.
Kentucky	59, 62, 63, 238, 255.
Louisiana	101, 137, 230, 249, 315, 437, 479, 488.
Maine	124.
Maryland	71, 85-88, 155, 157, 190, 196, 291, 351, 352, 361, 374, 451, 452.
Massachusetts	60, 147, 257, 320, 321, 346, 400.
Michigan	29, 82, 242, 248, 250, 273, 407.
Minnesota	26, 76, 77, 78, 81, 104, 117, 118, 120, 121, 153, 156, 170, 208, 211, 212, 223, 254, 264, 271, 277, 283, 287, 290, 347, 349.
Mississippi	141, 179, 180, 244, 247, 333, 448.
Missouri	24, 89, 127, 150, 231-233.
Montana	15, 16, 25, 34, 37, 38, 45, 46, 49, 50, 54, 57, 198-200, 202, 206, 207, 218-220, 282, 357, 358, 416.
Nebraska	18, 28, 217, 276, 278, 279, 284.
Nevada	2, 365.
New Hampshire	100, 338.
New Jersey	99, 134, 148, 237, 298, 429, 430, 461.
New Mexico	None.
New York	113, 114, 174, 213, 243, 269, 295, 304, 340, 342, 343, 399, 408, 410, 411, 438, 446.
North Carolina	90, 344, 345, 359, 409, 414, 424, 425, 460, 468, 505.
North Dakota	None.
Ohio	70, 116, 154, 171, 274, 362, 491.
Oklahoma	22, 32, 102, 129, 189, 197, 214, 315, 477, 486.
Oregon	138, 165, 173, 326-328, 353, 375, 376, 445, 472, 474, 476, 480, 482-485, 501.
Pennsylvania	61, 74, 103, 105, 128, 132, 136, 139, 142, 146, 152, 195, 256, 259-263, 302, 336, 337, 356, 412, 413, 455, 456, 459.
Rhode Island	91-98, 106-109, 133, 140, 258.
South Carolina	335.
South Dakota	17, 47, 193, 201.
Tennessee	145, 166, 182, 234, 245, 272, 373, 427, 453, 457, 481, 490.
Texas	119, 163, 183-185, 293, 297, 300, 306, 307, 309, 317, 354, 355, 367, 404, 405, 478.
Utah	11.
Vermont	252, 449, 503.
Virginia	111, 112, 192, 299, 363, 426, 428, 434, 435, 458, 504.
Washington	187, 188, 241, 280, 401, 402, 432, 450.

<i>State</i>	<i>Sample No.</i>
West Virginia-----	292, 439.
Wisconsin-----	64, 65, 72, 75, 131, 236, 239, 240, 246, 251, 275, 281, 288, 289, 294, 303.
Wyoming-----	9, 13, 39-44, 48, 56, 203, 204, 224.

SOURCE, DESCRIPTION, AND INDIVIDUAL ANALYSES OF HONEY AND HONEYDEW SAMPLES, AND AVERAGES BY STATE OF ORIGIN AND BY PLANT FAMILY

Full information on each honey sample is given in table 26. This includes crop year (1956 or 1957), date of removal from the bees, floral source or sources, comments offered by the producer or the authors, type and extent of heating the honey, a brief note on the physical condition of the sample when received at the laboratory, the producer's name and address, and the specific area of production of the honey sample. The State, when not given in the last column, is the same as the address of the producer. The location of each sample is shown on the map (fig. 1).

The samples are listed in alphabetical order by the common name of the principal floral source. In order to collect the highly important legume types together, the names are inverted. A few sources, named "clover" but not true clovers, are found elsewhere in the table, e.g. Mexican clover, deer clover. The unmodified designation "clover" is used for all samples so named by the producers. In addition, if the producer listed a number of clovers for a single sample, it has been designated "clover."

In general, if the producer indicated more than two floral sources, the sample is listed as a blend, further described according to time of harvesting. For some samples, the producer may have listed a third or fourth source but as present only in minor amounts. This is usually shown under "Comments."

We have included a considerable number of blends in this work. In many areas bee pasture of single plants is not extensive enough to permit harvesting single-types or even mixtures of a few floral types. Much honey is produced and sold in such areas, and it is hoped that by including information on time of collection and harvest, and specific location of production where possible, these blends will be sufficiently well characterized so that the data in this publication will be useful for these types of honey also. All blends are listed as natural; this implies that they were blended by the bees or at extraction, and not by mixing of known floral types by the beekeeper. They are characterized in time of production and harvesting as spring, summer, fall, or season (all three) blends. Such blends do not vary widely over the long run in one locality.

The time of removal from the bees is listed in table 26 as given by the producer. Samples occasionally were not received at the laboratory until several months later. Where a sample is described as unheated, a producer has so stated. If no information was given by the producer, this column was left blank. It had been emphasized in soliciting the sample that unheated samples were preferred.

The results of the analytical examination of the honey samples are detailed in table 27. This table is interleaved with table 26 so that full information is available on any sample without turning pages.

Where the number of samples of similar type justifies it, average values are inserted into table 27 following the group. For some important floral types, averages are given for each crop year, 1956 and 1957 followed by averages for both years. For example, in table 27, samples 1 to 10 (single space) are 1956 alfalfa, followed by their average. Next are given samples 11 to 23, 1957 alfalfa, followed by their average. The average for all alfalfa samples is given in the next line. Sample 24 is one-of-a-kind, with no average given. Sample 25 and 26 are both alfalfa-clover blends, and their average follows No. 26.

Samples 1 to 491 were classified by their producers as honey and the remainder, 492 to 505, as honeydew. Some floral-type honey samples were stated by the producers to contain some honeydew, and are so described in table 26. Many other samples probably contained some honeydew, judging by the flavor. After sample 505 are several lines of averages; their identities are given at that place.

The average values in table 27 are all simple numerical averages, except for the pH values. Here the numbers were necessarily converted to hydrogen ion concentration, averaged, and the result converted back to the logarithmic pH form.

In order to display all of the analytical information in one table, it was necessary to code two of the values, color and granulating tendency.

For color, the numbers refer to the U.S. Color Standards for extracted honey, with two numbers representing light and dark parts of each color class, as already described. The code is given on page 6.

Averaging these code numbers probably does not accurately represent the color of a mixture of the sample of various color classes, but it is indicative and we believe gives a useful idea of the "average" color of a group of samples.

The code values for granulation represent an increasing scale of granulation after storage under fixed conditions (see p. 6). It does not repeat the information given under "Condition" in table 26, but is considered supplemental to it. In most cases the degree of granulation given in table 26 under "Condition" is indicative of the behavior of the unheated, frequently unstrained, honey with whatever natural seeding it has been subjected to in extraction and handling by the beekeeper. In table 27 the data under "Granulation" gives some information on the tendency of the honey to granulate in undisturbed storage, after heating to eliminate seed crystals. The heating treatment used was actually milder than most commercial processing. Here again it might be debatable whether the average code number accurately depicts the granulating tendency of a mixture of samples, but since the numbers represent an increasing degree of granulation, and since granulating tendency depends on honey composition, we feel that this value is useful.

The values listed in table 27 under "Age" give the number of months between the removal of the honey from the hive and the carbohydrate analysis. We have found that the carbohydrate composition of honey changes with time (58). Data supporting this view were presented earlier in this bulletin. If for any reason it should be desirable to estimate the composition of honey as harvested or after certain

periods of storage, these "Age" values may be useful. This information is missing from previous compilations on honey composition. For example, the data published by Browne (9) resulted from analyses of honey samples gathered for an exposition in 1903; there is no indication of their age when analyzed.

The values for the sugars (and all other values in the table) are based on the honey sample at the moisture content shown in the table. As previously noted, under certain circumstances (sucrose and higher sugars each over 1 percent), melezitose was usually determined. All results are given under the column headed "melezitose" in table 27. Where the value .00 is recorded, no melezitose was found. A blank in this column shows that melezitose was not determined; it may have been present in small quantity. Averages in this column would be misleading whether calculated on the total number of samples or on the number of melezitose analyses and hence are not shown in the table.

The column in table 27 labeled "Undetermined" is intended to represent nonsugar material in the sample, since it is the difference between the total solids (100—moisture) and the sum of the five (in some cases, six) sugar determinations. Actually this value includes some sugar material not analyzed in the method. This is discussed in the sections on storage of honey and accuracy of carbohydrate analyses.

The pH values in the table are those of diluted honey solutions (13.25 percent) in carbon dioxide-free distilled water prior to the determination of acidity.

The next three columns are expressions of the acidity of the samples. All three are expressed as milliequivalents per kilogram of honey. This value is numerically equivalent to the reporting of milliliters of tenth normal alkali per hundred grams of honey. Acidity has been commonly expressed in past honey analyses as "percentage of formic acid". It has long been known that formic acid is of only minor importance in honey. A recent study of the acidity of honey (41) has shown that gluconic acid is the principal acid of honey, with citric acid next in importance. Many other acids have also been identified (41). The custom of expressing acidity of honey as formic acid is of no value, and since so many acids are present, it is more logical to give the values in milliequivalents per kilograms. These can be converted to "percentage of formic acid" if desired for comparative purposes by multiplying by 0.0046 or to "percentage of gluconic acid" by multiplying by 0.0196.

The first column, "Free acidity", corresponds to the acidity values previously reported for honey (9, 12, 25). The column labeled "lactone" is a new acidity measure for honey (56). It is probably largely gluconolactone (41). It does not include all of the gluconic acid in honey, since the lactone form of the acid is in equilibrium with the free acid form. The amount of lactone can be expressed as "percentage of gluconolactone" by multiplying by 0.0178. The column headed "Total acidity" is the sum of free and lactone acidity. The lactone content might be considered as a sort of "acidity reserve" since a partially neutralized honey will become more acid on standing due to hydrolysis of the lactone. The values in the column headed "lactone/free acid" are the ratio of lactone to free acidity.

Diastase values were determined on 292 honey samples. Of these, 272 had been stored at -20° C. immediately after receipt at the laboratory. Since deterioration in frozen storage is negligible, these values represent the diastase content of the samples as received from the producer. Nine of these samples are described in table 26 but not listed in table 27, since no other analyses were done on them. These values are as follows: No. 41, 10.3; No. 112, 33.3; No. 113, 14.3; No. 115, 46.2; No. 265, 14.6; No. 270, 15.8; No. 273, 41.4; No. 411, 10.9; No. 458, 26.7. The remaining 20 samples were analyzed for diastase after varying periods of room-temperature storage. These are listed in table 25, together with the age of the samples and the number of months elapsed before receipt of the sample. These values are, in general, low and show the effect of storage for 1 to 2 years at room temperature.

For 20 of the samples for which diastase was determined on the frozen portions, the portion stored at room temperature was also analyzed for diastase, thus providing information on the effect of room-temperature storage on diastase content of honey. This work is reported in detail earlier in this bulletin.

TABLE 25.—*Diastase content of samples stored at room temperature*

Sample No.	Age—		Diastase value
	At receipt	At analysis	
	<i>Months</i>	<i>Months</i>	
84.....	5	27	9. 4
86.....	11	27	14. 5
93.....	0	1	12. 8
102.....	8	12	13. 5
118.....	3	10	11. 5
119.....	5	13	13. 0
165.....	¹ 23	23	20. 7
180.....	19	26	8. 5
227.....	5	13	12. 2
292.....	6	12	8. 2
305.....	8	13	12. 0
310.....	0	10	8. 3
327.....	25	25	13. 2
328.....	4	11	6. 6
334.....	12	12	10. 8
407.....	1	22	7. 1
419.....	4	13	8. 6
429.....	1	10	31. 6
474.....	4	12	11. 2
484.....	6	13	4. 0

¹ Stored at 55° – 60° F. by producer.

Diastase values in the tables are expressed in the same units used in the older Gothe method. The diastase value is the number of centigrams of starch (ml. of 1-percent starch) converted to the prescribed end point per hour per gram of honey under the test conditions.

TABLE 26.—Source and description of honey samples

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
1.....	1956	Early Sep-tember.	Alfalfa.....	(KSC Apiary).....	None.....	.....	R. L. Parker, Manhattan, Kans..	Manhattan.
2.....	1956	Aug. 15.....	do.....	.....	.....	Beginning to gran- late.....	Paul McCart, Fernley, Nev.....	Lovelock Valley, Pershing County.
3.....	1956	July 15.....	do.....	Strained.....	110°.....	Granulated.....	William Ross, Valyermo, Calif.....	Kern County.
4.....	1956	Aug. 1.....	do.....	Unstrained.....	130°.....	Liquid.....	Jess Gentry, Oakdale, Calif.....	Stanislaus County.
5.....	1956	.....	do.....	.....	None.....	Beginning to gran- late.....	R. W. Taylor, Alhambra, Calif.....	Lancaster.
6.....	1956	July.....	do.....	.....	140°.....	Granulated.....	Hood Littlefield, Pasadena, Calif.....	Tehachapi.
7.....	1956	July.....	do.....	From isolated area.....	None.....	do.....	Delvin Ashurst, Westmorland, Calif.....	Imperial Valley.
8.....	1956	July.....	do.....	.....	do.....	do.....	O. P. Mandrapa, Calexico, Calif.....	Do.
9.....	1956	August.....	do.....	.....	100°.....	Partly granulated.....	Edward Varney, Sheridan, Wyo.....	Sheridan County.
10.....	1956	.....	do.....	.....	.....	Granulated.....	Laura Shephard, Calexico, Calif.....	Imperial County.
11.....	1957	Aug. 30.....	do.....	.....	120° for 2 hrs.....	Liquid.....	William P. Nye, Logan, Utah.....	Cache Valley, Cache County.
12.....	1957	.....	do.....	.....	None.....	Slight granulation.....	O. M. Bledsoe, Phoenix, Ariz.....	Maricopa County.
13.....	1957	July.....	do.....	Pure.....	do.....	Liquid.....	Harley K. Kittle, Riverton, Wyo.....	Fremont County.
14.....	1957	.....	do.....	Not processed.....	do.....	do.....	T. A. James, Rocky Ford, Colo.....	Rocky Ford.
15.....	1957	Sept. 15.....	do.....	.....	do.....	Crystals.....	Joe Barrow, Ekalaka, Mont.....	Carter County.
16.....	1957	.....	do.....	.....	.....	Partly granulated.....	C. J. Clark, Sun River, Mont.....	Sun River.
17.....	1957	.....	do.....	Unstrained (very turbid).....	None.....	Liquid.....	Robert C. Fox & Son, Fruitdale, S. Dak.....	Butte County.
18.....	1957	Aug. 22.....	do.....	Unstrained.....	do.....	Crystals.....	Charley W. Moosman, Valentine, Nebr.....	Cherry County.
19.....	1957	Aug. 25.....	do.....	Also 2% clover.....	.....	Granulated.....	Belliston Bros., Burley, Idaho.....	Cassia County.
20.....	1957	Aug. 11.....	do.....	Unstrained.....	130° for 15 min.....	Liquid.....	Charles B. Crispin, Grimes, Iowa.....	Prairie region, Dallas County.
21.....	1957	July.....	do.....	Strained.....	130°.....	Partly granulated.....	John Allred, Madera, Calif.....	San Joaquin Valley.
22.....	1957	July.....	do.....	.....	None.....	Liquid.....	Glenn Gibson, Minco, Okla.....	Harmon County.
23.....	1957	.....	do.....	.....	.....	Soft granulation.....	Phillips & Blaylock, Chowchilla, Calif.....	Fresno County.
24.....	1956	Late August.....	Alfalfa-blue vine.....	.....	160°.....	Liquid.....	Carl Kalthoff, Lexington, Mo.....	Lafayette and Saline Counties.
25.....	1957	.....	Alfalfa-mixed clover.....	White, alsike and sweet clovers.....	.....	Partly granulated.....	J. D. Harrah, Charlo, Mont.....	Charlo.
26.....	1957	Mid-August.....	Alfalfa-clover.....	.....	None.....	Many crystals.....	Mrs. Phil Chaffin, St. Cloud, Minn.....	Haven Township, Sherburne County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups

Sample No.	Color	Granulation	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meg./kg.	Meg./kg.	Meg./kg.		Percent	Percent	
1	4	4	15.6	10	39.23	35.01	2.45	6.13	1.28	-----	0.4	3.80	21.83	12.06	33.89	0.552	0.069	0.039	19.1
2	4	8	14.1	7	37.50	32.56	7.57	6.15	1.20	-----	1.2	4.21	7.33	1.98	9.31	.270	.050	.021	14.2
3	4	4	17.0	13	38.82	33.15	.83	5.39	.91	-----	3.9	3.85	16.60	8.04	24.64	.433	.050	.027	-----
4	1	9	16.2	13	38.99	33.65	2.50	5.97	.69	-----	2.0	3.70	18.77	10.81	29.58	.578	.055	.028	16.9
5	3	9	15.1	14	40.87	33.48	2.05	6.87	1.09	-----	.5	3.80	17.20	7.27	24.47	.422	.062	.028	18.2
6	5	9	16.4	14	36.44	34.42	.98	5.18	.97	-----	5.6	3.80	18.04	8.20	26.24	.453	.050	.032	-----
7	5	8	15.7	14	37.47	33.00	5.73	5.37	.98	-----	1.7	3.93	14.77	6.45	21.22	.438	.090	.012	-----
8	9	9	16.0	14	38.76	35.11	2.33	5.41	.62	-----	1.8	3.88	26.48	10.87	37.35	.412	.318	.031	-----
9	6	5	17.4	15	38.68	34.17	1.90	6.03	.64	-----	1.2	3.78	16.71	8.26	24.97	.494	.049	.037	-----
10	9	8	15.2	28	38.87	33.92	2.47	7.42	.76	-----	1.4	3.75	30.93	14.42	45.35	.466	.174	.055	-----
Ave., 1-10	5	7	15.9	14	38.56	33.85	2.88	5.99	.89	-----	2.0	3.83	18.87	8.84	27.70	.457	.097	.031	17.1
11	4	2	14.2	6	41.54	32.02	1.16	7.14	1.29	-----	2.6	4.00	18.89	5.45	24.34	.289	.123	.015	22.2
12	8	5	16.3	6	39.84	34.04	2.42	5.44	.53	-----	.9	3.70	29.83	12.03	41.86	.403	.160	.045	-----
13	0	2	16.8	8	38.77	32.62	4.22	5.60	.82	-----	1.2	3.68	13.61	4.20	17.81	.309	.035	.020	-----
14	4	8	17.5	7	39.96	33.48	2.97	4.72	.65	-----	.7	3.60	22.23	10.70	32.92	.481	.071	.034	21.9
15	2	4	17.0	7	39.46	33.17	2.86	4.76	.74	-----	2.0	3.91	12.38	5.16	17.54	.417	.047	.028	19.0
16	1	5	17.0	8	39.39	34.03	1.98	5.54	.68	-----	1.4	3.80	15.46	7.93	23.40	.513	.051	.028	-----
17	0	6	15.4	8	39.21	33.31	2.65	6.68	.90	-----	1.8	4.05	9.22	3.24	12.46	.351	.038	.018	13.2
18	1	7	16.9	8	38.69	34.49	3.15	5.14	.68	-----	.9	3.97	11.83	4.82	16.65	.407	.048	.024	13.3
19	3	4	15.7	9	39.41	33.46	1.65	6.32	.72	-----	2.6	3.99	12.94	6.42	19.36	.496	.056	.029	-----
20	3	4	18.3	9	37.76	34.53	1.41	5.49	1.90	-----	.5	3.80	20.31	7.01	27.32	.345	.138	.040	21.4
21	8	5	16.5	14	39.04	34.89	1.01	6.29	.84	-----	1.4	3.90	32.28	11.15	43.43	.345	.200	.071	-----
22	2	4	14.4	15	38.37	33.12	4.80	6.83	.84	-----	1.6	3.68	15.84	7.65	23.46	.483	.078	.030	12.9
23	8	0	18.3	15	42.50	26.64	1.68	8.31	.83	-----	1.8	3.63	29.83	13.80	43.62	.463	.134	.057	-----
Ave., 11-23	3	4	16.5	9	39.53	33.06	2.46	6.02	.89	-----	1.5	3.80	18.82	7.66	26.47	.408	.091	.034	17.7
Ave., 1-23	4	6	16.2	11	39.11	33.40	2.64	6.01	.89	-----	1.7	3.81	18.84	8.17	27.01	.429	.093	.033	17.5
24	6	1	14.9	14	35.62	28.45	6.01	6.43	4.69	1.16	2.8	3.88	20.19	10.16	30.35	.501	.077	.026	3.1
25	1	6	15.2	7	40.77	33.92	3.07	5.26	.79	.47	.5	3.87	12.94	7.11	20.05	.550	.047	.028	-----
26	5	0	20.2	9	37.79	30.47	.66	6.64	1.19	-----	3.0	3.89	18.79	5.33	24.12	.284	.086	.045	-----
Ave., 25-26	3	3	17.7	8	39.28	32.20	1.87	5.95	.99	-----	1.8	3.88	15.87	6.22	22.09	.417	.067	.037	-----

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
27.....	1957	-----	Alfalfa-cotton.....	-----	None.....	Beginning to granulate.....	C. M. Bledsoe, Phoenix, Ariz.....	Maricopa County.
28.....	1956	-----	Alfalfa-goldenrod.....	From commercial packed cans, unstrained; only a little goldenrod.	155°.....	.....do.....	E. H. Adee, Sutherland, Nebr.....	Sutherland.
29.....	1957	Sept. 16.....	.....do.....	M. S. U. apiary.....	-----	Partly granulated.....	E. C. Martin, Lansing, Mich.....	Ingham County.
30.....	1957	-----	Alfalfa-honeydew.....	-----	-----	Granulated.....	Gene Sanders, Grand Junction, Colo.....	Grand Junction.
31.....	1957	-----	Alfalfa-mesquite.....	-----	None.....	Beginning to granulate.....	C. M. Bledsoe, Phoenix, Ariz.....	Maricopa County.
32.....	1956	July.....	Alfalfa-sunflower.....	Slight touch of sunflower (commercial sample very clear).	-----	Liquid.....	R. L. Blackwell, Oklahoma City, Okla.....	Oklahoma City.
33.....	1956	Aug. 1.....	Alfalfa-sweet clover.....	-----	None.....	Beginning to granulate.....	R. D. Bradshaw & Sons, Wendell, Idaho.....	Rupert.
34.....	1956	Aug. 10.....	.....do.....	-----	.....do.....	.....do.....	Lawrence Buhmann, Zurich, Mont.....	Zurich.
35.....	1956	-----	.....do.....	-----	115°.....	Partly coarse granulated.....	J. W. Holzberlein, Meeker, Colo.....	White River Valley, near Meeker.
36.....	1956	-----	Alfalfa-white sweet clover.....	95% alfalfa.....	-----	Granulated.....	L. R. Budge, Malad City, Idaho.....	Curlew Valley.
37.....	1956	October.....	Alfalfa-sweet clover.....	-----	90°.....	Solid granulation.....	Cloverdale Apiaries, Manhattan, Mont.....	Townsend.
38.....	1956	September.....	.....do.....	Collected August-September.	140°.....	Liquid.....	Al Chenovick, Helena, Mont.....	Helena.
39.....	1956	.....do.....	.....do.....	-----	140° for 1 hr.....	.....do.....	R. A. Bryant, Worland, Wyo.....	Washakie, Hot Springs and Big Horn Counties.
40.....	1956	.....do.....	.....do.....	-----	110° for 1 hr.....	Solid granulation.....	Hanson Honey Co., Greybull, Wyo.....	Park and Big Horn Counties.
41.....	1956	.....do.....	.....do.....	-----	150°.....	Liquid.....	Rauchfuss Apiaries, Powell, Wyo.....	Park County.
42.....	1956	August.....	.....do.....	-----	None.....	Granulated.....	Sterling Johnson, Lovell, Wyo.....	Big Horn County.
43.....	1956	.....do.....	.....do.....	90% alfalfa.....	.....do.....	Solid granulation.....	Clifford Reed, Ranchester, Wyo.....	Sheridan County.
44.....	1956	September.....	.....do.....	-----	90° for 1 hr.....	.....do.....	J. M. Osborn, Buffalo, Wyo.....	Johnson County.
45.....	1956	Aug. 1.....	.....do.....	-----	125°.....	Soft granulation.....	Howard Foster, Colusa, Calif.....	Winnet, Mont.
46.....	1956	Aug. 10.....	.....do.....	-----	140°.....	Few crystals.....	Alex Martin, Hardin, Mont.....	Hardin.
47.....	1957	Sept. 1.....	.....do.....	60% alfalfa, 30% white sweet clover, 10% yellow sweet clover.	None.....	Liquid.....	J. T. McIntire, Fruitdale, S. Dak.....	Butte County.
48.....	1957	-----	.....do.....	Some yellow sweet clover.	.....do.....	Beginning to granulate.....	W. R. Thompson, Lander, Wyo.....	Lander.
49.....	1957	Sept. 1.....	.....do.....	-----	130°.....	Crystals.....	H. W. Pierce, Fairfield, Mont.....	Teton County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meg./kg	Meg./kg	Meg./kg		Percent	Percent	
27-----	7	5	16.3	7	37.93	35.36	2.27	5.08	0.46	0.43	02.2	04.02	30.75	10.46	41.22	0.340	0.355	0.042	-----
28-----	5	4	16.9	11	37.38	32.77	1.19	6.67	.89	-----	4.2	3.82	18.96	8.55	27.51	.452	.066	.037	17.1
29-----	5	4	18.4	6	39.66	31.85	.92	5.77	.99	-----	2.4	3.89	23.49	9.51	33.00	.405	.113	.041	26.9
Ave., 28-29	5	4	17.7	9	38.52	32.31	1.06	6.22	.94	-----	3.3	3.85	21.23	9.03	30.26	.429	.090	.039	22.0
30-----	8	2	15.9	3	37.23	30.02	1.16	7.66	2.66	-----	5.4	4.90	34.84	1.20	36.04	.034	.487	.072	-----
31-----	7	4	17.3	7	40.14	32.60	1.69	5.26	.45	.72	1.8	3.88	16.59	9.86	26.45	.594	.143	.034	-----
32-----	4	4	17.4	7	39.39	32.21	1.10	6.45	.72	-----	2.8	3.73	20.55	9.32	29.72	.453	.088	.042	17.3
33-----	1	7	16.2	11	39.82	35.14	.91	5.96	.87	-----	1.1	3.79	12.48	5.84	18.32	.468	.048	.021	10.9
34-----	3	6	16.2	11	36.26	35.45	.90	6.60	1.03	-----	3.6	3.90	12.96	4.58	17.53	.354	.049	.025	12.6
35-----	2	4	15.8	3	40.61	34.62	1.53	5.35	.80	-----	1.3	3.81	16.87	7.37	24.24	.436	.063	.047	21.4
36-----	2	9	14.8	12	40.51	35.53	.50	5.92	.73	-----	2.1	4.00	10.40	4.42	14.82	.423	.057	.022	-----
37-----	1	7	17.8	13	38.72	33.41	2.59	5.50	.65	-----	1.3	3.78	13.90	6.17	20.07	.444	.067	.030	-----
38-----	1	9	-----	10	-----	-----	-----	-----	-----	-----	-----	4.12	6.75	2.51	9.25	.372	-----	-----	3.0
39-----	4	5	16.0	13	37.81	33.34	4.33	5.85	.79	-----	1.9	3.90	13.07	4.87	17.94	.373	.064	.028	2.1
40-----	1	6	15.1	13	39.14	32.81	2.51	6.84	1.19	-----	2.4	3.92	9.16	3.86	13.01	.422	.035	.020	-----
42-----	1	8	15.8	15	38.41	34.13	2.75	5.86	.89	-----	2.2	3.90	10.36	4.37	14.73	.422	.033	.020	-----
43-----	2	8	15.1	15	39.80	35.18	1.06	5.96	.73	-----	2.2	3.93	9.59	3.65	13.24	.380	.029	.020	-----
44-----	1	5	16.6	14	39.68	35.29	1.77	5.29	.71	-----	.7	3.82	11.69	5.34	17.03	.457	.034	.019	-----
45-----	1	9	15.9	15	38.40	32.77	6.54	5.33	.74	.00	.3	4.09	6.50	2.18	8.68	.336	.018	.015	-----
46-----	4	8	-----	12	-----	-----	-----	-----	-----	-----	-----	3.80	14.66	8.25	22.91	.562	-----	-----	-----
Ave., 33-46	2	7	15.9	12	39.01	34.33	2.31	5.86	.83	-----	1.7	3.89	11.41	4.88	16.29	.419	.045	.024	10.0
47-----	1	3	16.5	5	38.72	33.35	1.75	5.75	.68	.00	3.3	3.80	11.81	2.55	14.36	.216	.026	.019	-----
48-----	1	1	15.7	6	41.00	33.00	1.52	7.02	.82	-----	.9	3.80	13.43	2.23	15.66	.166	.049	.019	-----
49-----	1	1	15.8	6	39.55	33.68	4.18	5.44	.77	.00	.6	4.10	9.65	3.11	12.76	.322	.031	.02	10.70

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producers heating, °F.	Condition on receipt	Name and address of producer	Area produced
50.....	1957	August.....	Alfalfa-clover.....		None.....	Crystals.....	Joe Barrow, Ekalaka, Mont.....	Ekalaka.
51.....	1957	Sept. 12.....	Alfalfa-sweet clover.....	White and yellow sweet clover.	do.....	Granulated.....	Robert VandeHoef, Boyden, Iowa.....	Sioux County.
52.....	1957	Aug. 25.....	do.....	Water white.....	120°.....	Liquid.....	Jack Holzberlein, Meeker, Colo.....	Rio Blanco and Moffat Counties.
53.....	1957	Aug. 25.....	do.....	Extra white.....	120°.....	do.....	do.....	Do.
54.....	1957	.....	do.....	.....	85°.....	Partly granulated.....	Walter G. Sagunsky, Sheridan, Mont.....	Sheridan.
55.....	1957	.....	do.....	.....	.....	Liquid.....	Gene Sanders, Grand Junction, Colo.....	Grand Junction.
56.....	1957	Aug. 1.....	do.....	Some yellow sweet clover.	Mild.....	Crystals.....	Charlie G. Miller, Riverton, Wyo.....	Fremont County.
57.....	1957	Aug. 15.....	do.....	Produced 7/10-8/15, from irrigated valley.	None.....	Solid granulation.....	Lester W. Hall, Livingston, Mont.....	Park County.
58.....	1956	Aug. 15.....	Alfalfa-yellow sweet clover.	Also rabbit-brush and other weeds.	110°.....	Complete fine granulation.	S. J. Watkins, Grand Junction, Colo.....	Grand Valley.
59.....	1956	.....	Aster.....	.....	.....	Granulated.....	E. M. Miller, Eastwood, Ky.....	Eastwood.
60.....	1956	.....	do.....	.....	.....	Layer of crystals.....	Justin Caswell, Middleboro, Mass.....	Middleboro.
61.....	1957	Oct. 10.....	do.....	.....	.....	Solid granulation.....	Andrew McShaw, Transfer, Pa.....	Lawrence County.
62.....	1956	.....	do.....	.....	155°.....	Granulated.....	Robert Vance, Pleasureville, Ky.....	Pleasureville.
63.....	1957	.....	do.....	.....	None.....	Solid granulation.....	do.....	Do.
64.....	1957	.....	Aster-natural fall blend.	.....	.....	do.....	Burt L. Snyder, New Auburn, Wis.....	New Auburn.
65.....	1957	Oct. 1.....	Aster-goldenrod.....	Unstrained.....	do.....	Soft granulation.....	Vernon G. Howard, Milwaukee, Wis.....	Milwaukee.
66.....	1957	.....	do.....	.....	.....	Crystals.....	Allen D. Brooks, Charlestown, Ind.....	Charlestown.
67.....	1957	Aug. 25.....	Athel tree.....	.....	None.....	Soft granulation.....	Clarence L. Benson, Phoenix, Ariz.....	Salt River Valley, Maricopa County.
68.....	1957	Sept. 27.....	do.....	100% pure.....	do.....	Solid granulation.....	Charles D. Morse, Lakeside, Calif.....	Borego Valley, San Diego County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			<i>Percent</i>	<i>Month</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		<i>Meg./kg</i>	<i>Meg./kg</i>	<i>Meg./kg</i>		<i>Percent</i>	<i>Percent</i>	
50.....	1	1	15.6	8	40.46	32.90	1.96	6.28	0.96	0.00	1.8	4.13	10.77	3.18	13.95	0.295	0.042	.026	17.0
51.....	2	1	19.8	10	37.52	33.54	.91	5.40	.66	-----	2.2	3.58	20.67	8.05	28.71	.390	.059	.033	-----
52.....	1	4	16.1	11	40.09	32.48	.97	6.87	1.02	.62	1.9	3.70	15.72	5.73	21.43	.365	.065	.035	20.0
53.....	2	1	15.6	11	40.38	29.40	.96	8.92	1.67	-----	3.1	3.92	13.80	3.40	17.21	.246	.077	.036	22.4
54.....	1	9	15.0	12	40.11	33.95	1.55	7.07	1.32	-----	1.0	3.80	12.34	4.00	16.34	.324	.052	.028	-----
55.....	5	4	16.3	13	38.44	33.80	1.36	6.62	.81	-----	2.7	4.10	16.89	5.01	21.90	.297	.122	.045	16.4
56.....	1	2	17.0	13	38.35	32.64	1.92	7.39	1.06	-----	1.6	3.80	10.26	3.60	13.86	.351	.037	.016	-----
57.....	1	7	16.4	16	40.62	32.17	1.61	7.27	1.07	-----	.9	4.02	8.85	.95	9.80	.107	.039	.017	-----
Ave., 47-57...	2	3	16.3	10	39.57	32.81	1.70	6.73	.99	-----	1.8	3.85	13.11	3.80	16.91	.280	.054	.027	17.3
Ave., 33-57...	2	5	16.1	11	39.29	33.57	2.00	6.30	.91	-----	1.8	3.87	12.19	4.39	16.57	.355	.050	.026	13.6
58.....	7	9	14.9	7	40.82	34.76	1.16	5.33	1.08	-----	2.0	4.11	29.45	10.21	39.66	.354	.235	.075	26.5
59.....	6	1	16.2	12	39.00	31.55	.61	8.53	1.32	-----	2.8	4.75	15.82	2.25	18.07	.142	.196	.031	-----
60.....	8	8	17.0	12	37.80	35.53	.75	4.92	1.26	-----	2.7	4.48	19.68	3.46	23.14	.176	.240	.036	-----
61.....	6	1	18.6	9	37.73	30.43	.70	8.08	.59	-----	3.9	4.87	19.94	.15	20.09	.008	.373	.043	-----
62.....	7	1	17.1	35	36.81	29.94	.97	10.50	1.01	-----	3.7	4.82	18.85	1.20	20.05	.064	.344	.046	-----
63.....	6	1	18.0	14	36.42	29.19	1.01	10.22	1.01	-----	4.2	4.60	26.82	3.77	30.59	.141	.358	.058	-----
Ave., 59-63...	7	2	17.4	16	37.55	31.33	.81	8.45	1.04	-----	3.5	4.68	20.22	2.17	22.39	.106	.302	.043	-----
64.....	4	1	18.2	14	37.36	29.42	.84	8.80	1.53	-----	3.9	4.38	17.21	3.45	20.66	.201	.174	.046	-----
65.....	7	4	18.0	11	38.89	31.63	.55	7.31	.75	-----	2.9	3.70	26.93	8.75	35.68	.325	.108	.084	-----
66.....	7	2	18.6	14	38.47	31.62	1.09	6.99	.79	-----	2.4	4.10	31.27	8.19	39.46	.262	.265	.064	-----
Ave., 65-66...	7	3	18.3	13	38.68	31.63	.82	7.15	.77	-----	2.7	3.86	29.10	8.47	37.57	.294	.187	.074	-----
67.....	8	7	16.3	13	38.66	36.19	1.81	4.81	.41	-----	1.8	4.10	31.25	2.88	34.13	.092	.370	.056	-----
68.....	7	9	14.3	12	40.84	39.11	.78	3.66	.13	-----	1.2	4.09	29.05	8.84	37.89	.304	.240	.069	-----
Ave., 67-68...	8	8	15.3	13	39.75	37.65	1.30	4.24	.27	-----	1.5	4.09	30.15	5.86	36.01	.198	.305	.063	-----

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
69.....	1956	Dec. 1.....	Bamboo, Japanese.	(U. F. Apiary).....	None.....	Liquid.....	Frank Robinson, Gainesville, Fla.	Gainesville.
70.....	1956	July.....	Basswood.....	.....	135°.....	do.....	H. R. Swisher, Springfield, Ohio.	Clark County.
71.....	1956	.....	do.....	.....	"Very low".....	do.....	J. H. Lindner, Cumberland, Md.	Maryland and West Virginia.
72.....	1957	.....	do.....	Nearly pure limestone hill area.	None.....	Solid granulation.....	H. A. Schaefer, Osseo, Wis.....	Southern Trempealeau County.
73.....	1957	Aug. 11.....	Basswood-catnip.	From a wooded area.	130° for 15 min.	Liquid.....	Charles B. Crispin, Grimes, Iowa.	Kingman, Polk County.
74.....	1956	October.....	Basswood-clover..	Strained.....	120°.....	do.....	Paul G. Cummins, Conshohocken, Pa.	Pine Forge.
75.....	1956	.....	do.....	.....	None.....	Granulated.....	H. A. Schaefer, Osseo, Wis.....	Osseo.
76.....	1956	.....	do.....	.....	do.....	do.....	.....	Winona County, Minn.
77.....	1957	Aug. 15.....	do.....	Strained.....	100°.....	Solid granulation.....	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth & Martin Counties.
78.....	1957	.....	Basswood-sweet clover.	.....	.....	Granulated.....	Elmer E. Viklo, Lonsdale, Minn..	Lonsdale.
79.....	1956	August.....	Bean, Lima.....	Strained 80 mesh.....	130°.....	Liquid.....	Charles Johnson, Empire Calif....	Stanislaus County.
80.....	1957	.....	do.....	Strained.....	To melt.....	do.....	Paul Jaun, Dos Palos, Calif.....	Merced County.
81.....	1957	Sept. 5.....	Bean, Lima-hearts-ease.	Produced 8/15-9/5; strained.	100°.....	Soft granulation.....	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth & Martin Counties.
82.....	1956	Aug. 28.....	Bean, pea-sweet clover.	Beans, 80%; sweet clover, 10%; wild-flowers, mostly goldenrod, 10%. From unfinished combs; nearly pure.	None.....	Beginning to granulate.	George J. Lengst, Tuscola, Mich....	Tuscola.
83.....	1957	.....	Bergamot.....	.....	do.....	Crystals.....	Thomas A. Ott, Columbia City, Ind.	Noble County.
84.....	1956	May.....	Blackberry.....	(Gallberry flavor).....	do.....	Liquid.....	J. H. Girardeau, Jr., Tifton, Ga....	Tift County.
85.....	1956	June 2.....	do.....	.....	do.....	Partly granulated..	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
86.....	1956	May.....	do.....	.....	.....	Liquid.....	Leonard M. Llewellyn, Laurel, Md.	Prince Georges County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg	Meq./kg	Meq./kg		Percent	Percent	
69.....	6	1	19.1	8	35.58	29.27	0.65	9.80	1.95	-----	3.7	4.08	20.42	4.67	25.09	0.229	0.142	0.054	20.8
70.....	5	5	17.4	15	38.60	32.83	1.73	5.44	1.04	-----	3.0	3.92	20.62	8.19	29.81	.396	.110	.023	-----
71.....	5	1	17.0	15	36.99	30.12	.63	8.02	1.87	-----	5.4	4.28	17.84	7.89	25.74	.441	.068	.024	-----
72.....	1	2	17.9	16	38.04	31.83	1.25	7.12	1.40	.00	2.5	4.01	11.89	3.66	15.55	.308	.074	.020	-----
Ave., 70-72...	4	3	17.4	15	37.88	31.59	1.20	6.86	1.44	-----	3.6	4.05	16.78	6.58	23.70	.382	.084	.022	-----
73.....	4	2	19.1	9	39.25	33.50	.92	5.15	.66	-----	1.4	3.63	27.05	8.49	35.54	.314	.119	.041	30.9
74.....	7	0	17.4	10	35.83	29.36	.93	6.80	2.62	-----	7.1	3.93	27.28	8.63	35.91	.316	.169	.053	30.9
75.....	3	4	18.2	12	37.42	32.91	.34	5.83	1.51	-----	3.8	4.02	18.68	8.12	26.80	.434	.144	.024	20.7
76.....	2	4	19.0	12	37.02	32.83	.38	5.91	1.21	-----	3.7	3.80	21.06	8.84	29.90	.418	.096	.026	-----
77.....	4	1	19.3	13	37.57	31.41	.47	6.49	1.18	-----	3.6	3.90	18.27	6.55	24.82	.359	.134	.037	-----
Ave., 74-77...	4	2	18.5	12	36.96	31.63	.53	6.26	1.63	-----	4.6	3.91	21.32	8.04	29.36	.382	.136	.035	25.8
78.....	2	1	20.2	11	37.28	32.14	.56	6.25	.83	-----	2.7	3.80	16.74	7.14	23.88	.427	.091	.027	-----
79.....	1	7	15.0	13	38.87	33.18	4.43	5.35	.95	-----	2.2	3.69	17.58	10.23	27.81	.586	.037	.024	16.0
80.....	4	4	15.5	14	39.29	33.02	1.90	6.53	.89	-----	2.9	3.81	18.22	6.60	24.82	.362	.105	.040	-----
Ave., 79-80...	3	6	15.3	14	39.08	33.10	3.17	5.94	.92	-----	2.6	3.75	17.90	8.42	26.32	.474	.071	.032	-----
81.....	4	3	19.7	12	38.22	31.14	.85	6.27	.90	-----	2.9	3.70	22.53	6.25	28.78	.277	.085	.057	-----
82.....	6	4	18.3	11	36.67	33.54	.70	5.12	2.01	-----	3.7	4.03	34.09	11.68	45.77	.344	.211	.058	25.9
83.....	7	1	17.0	13	39.96	30.99	.77	6.30	1.53	-----	3.4	3.75	27.86	12.55	40.41	.451	.139	.065	-----
84.....	4	0	16.6	10	41.28	27.84	1.19	8.47	1.57	-----	3.1	4.10	13.43	3.96	17.35	.294	.166	.033	-----
85.....	10	0	16.1	15	36.07	25.64	1.84	11.43	3.19	.00	5.7	5.00	31.68	1.27	32.95	.040	.468	.069	14.0
86.....	10	0	16.4	18	35.57	24.33	.78	14.09	2.75	-----	6.1	5.25	37.00	.07	37.07	.002	.562	.062	-----
Ave., 84-86...	8	0	16.4	14	37.64	25.94	1.27	11.33	2.50	-----	5.0	4.50	27.37	1.76	29.11	.112	.399	.055	-----

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
87.....	1956	June.....	Blackberry-tulip tree.	-----	160°.....	Liquid.....	Brother Patrick, Ammendale, Md.	Ammendale.
88.....	1956	-----	do.....	-----	Yes.....	do.....	Harold L. Kelly, Silver Spring, Md.	Montgomery County.
89.....	1956	July.....	Natural Spring blend.	Wild flowers, no clover.	None.....	do.....	Otto Aiple, St. Louis, Mo.	Crawford County.
90.....	1956	-----	do.....	In comb.....	do.....	do.....	Stephen Jurash, Elizabeth City, N.C.	Pasquotank County.
91.....	1957	July 9.....	do.....	-----	do.....	do.....	Everett E. Fields, Bristol, R.I.	Bristol.
92.....	1957	July 20.....	do.....	-----	do.....	do.....	Alice Quinn, Providence, R.I.	Providence.
93.....	1957	July 13.....	do.....	-----	do.....	do.....	Percy W. McIntosh, Lakewood, R.I.	Lakewood.
94.....	1957	July 13.....	do.....	-----	do.....	do.....	-----	Gaspee Area.
95.....	1957	June 28.....	do.....	-----	do.....	Crystals.....	Mrs. Rana B. Walker, Edgewood, R.I.	Edgewood.
96.....	1957	June 30.....	do.....	-----	do.....	Liquid.....	Robert Murray, Warwick, R.I.	Warwick.
97.....	1957	July 8.....	do.....	Fruit blossoms.....	None.....	do.....	H. J. Andrews, Bristol, R.I.	Bristol.
98.....	1957	July 12.....	do.....	-----	do.....	do.....	Walter Starzak, N. Smithfield, R.I.	North Smithfield.
99.....	1957	June 21.....	do.....	Cherry, pear, peach, dandelion, alfalfa & rose.	-----	do.....	Porter H. Evans, Morristown, N.J.	Mendham Township, Morris County.
100.....	1956	Aug. 15.....	Natural summer blend.	-----	None.....	do.....	J. R. Hepler, Durham, N.H.	Strafford County.
101.....	1956	-----	do.....	-----	150°.....	do.....	E. C. Bessonnet, Donaldsonville, La.	Donaldsonville.
102.....	1956	-----	do.....	Hairy vetch, wild flowers, alfalfa & sweet clover (A & M apiary).	-----	do.....	G. A. Bieberdorf, Stillwater, Okla.	Stillwater.
103.....	1956	August.....	do.....	Unstrained.....	None.....	Solid granulation.....	F. W. Schwoebel, Philadelphia, Pa.	Morris Arboretum, Montgomery County.
104.....	1956	Sept. 14.....	do.....	-----	Below 100°.....	Liquid.....	James J. Sullivan, Minneapolis, Minn.	Le Center.
105.....	1957	-----	do.....	Unstrained.....	None.....	do.....	Albert Bochmann, Downingtown, Pa.	Downingtown.
106.....	1957	July 7.....	do.....	-----	do.....	do.....	Kenneth Bowen, Bristol, R.I.	Bristol.
107.....	1957	-----	do.....	-----	140°.....	do.....	Carl J. Manfred, Jr., Westerly, R.I.	Westerly.
108.....	1957	July 12.....	do.....	-----	120°.....	Liquid.....	Gaston Levitre, Woonsocket, R.I.	Woonsocket.
109.....	1957	July 10.....	do.....	-----	130°.....	do.....	Steve Abrants, Woonsocket, R.I.	Do.
110.....	1957	Aug. 10.....	do.....	-----	None.....	do.....	H. E. Werner, Swanwyck, Del.	New Castle County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			<i>Percent</i>	<i>Month</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>			<i>Meg./kg</i>	<i>Meg./kg</i>	<i>Meg./kg</i>	<i>Percent</i>	<i>Percent</i>	
87-----	10	1	17.1	17	35.46	27.09	0.92	7.96	4.40	-----	7.1	4.65	34.61	2.80	37.41	0.081	0.187	0.074	-----
88-----	9	1	17.3	16	35.95	27.49	.58	10.91	2.72	-----	5.0	4.80	28.58	2.55	31.13	.089	.400	.053	-----
Ave., 87-88---	10	1	17.2	17	35.71	27.29	.75	9.44	3.56	-----	6.1	4.72	31.60	2.68	34.27	.085	.294	.064	-----
89-----	8	1	19.6	12	37.88	28.73	.69	7.39	1.13	-----	4.6	3.98	40.50	11.76	52.26	.290	.301	.072	42.3
90-----	6	1	16.2	16	41.77	31.07	2.20	6.68	1.01	-----	1.1	4.03	18.71	7.31	26.02	.391	.115	.029	10.3
91-----	6	2	16.6	21	35.71	30.17	.91	9.45	1.49	-----	5.1	4.11	27.07	12.39	39.46	.458	.398	.048	38.0
92-----	6	1	-----	26	-----	-----	-----	-----	-----	-----	-----	4.15	21.66	5.32	26.98	.246	-----	-----	38.7
93-----	6	6	16.8	6	39.30	32.39	.37	6.15	1.49	-----	3.5	4.48	18.04	4.66	22.70	.258	.286	.019	-----
94-----	6	0	16.6	22	36.58	28.83	.91	10.61	1.48	-----	5.0	4.51	15.78	2.62	18.40	.166	.300	.053	19.1
95-----	6	4	-----	1	-----	-----	-----	-----	-----	-----	-----	4.08	22.56	8.75	31.31	.387	-----	-----	-----
96-----	8	2	14.2	23	35.96	26.31	1.03	13.61	2.14	-----	6.7	4.30	23.90	9.21	33.11	.385	.363	.069	27.8
97-----	4	4	-----	2	-----	-----	-----	-----	-----	-----	-----	3.67	20.13	8.08	28.21	.401	-----	-----	9.0
98-----	7	1	16.8	22	36.48	27.27	1.18	11.71	1.97	-----	4.6	4.09	26.63	10.39	37.02	.390	.377	.068	21.7
99-----	8	0	16.4	16	33.79	27.23	1.12	11.97	3.43	.58	5.5	4.34	29.66	4.32	33.99	.146	.340	.059	27.3
Ave., 89-99---	6	2	16.7	14	37.18	29.00	1.05	9.70	1.77	-----	4.5	4.09	23.79	7.65	31.44	.321	.310	.052	26.0
100-----	8	0	15.5	10	38.83	31.14	.91	7.45	3.55	-----	2.4	4.10	25.96	8.59	34.55	.330	.195	.049	20.0
101-----	9	2	18.4	9	38.95	32.69	1.07	7.02	.95	-----	.9	3.89	25.08	9.18	34.26	.366	.132	.046	15.4
102-----	9	4	16.8	16	39.72	31.72	.80	7.19	.86	.00	2.9	3.85	33.27	11.05	44.31	.333	.145	.059	-----
103-----	6	1	17.2	16	36.85	28.98	.50	9.00	1.59	-----	5.9	4.59	25.71	1.97	27.68	.077	.361	.043	20.0
104-----	5	1	17.2	28	38.75	31.66	.98	8.95	1.32	-----	1.1	4.02	13.68	4.43	18.11	.324	.107	.032	10.8
105-----	5	0	17.4	5	38.22	29.92	.47	8.53	1.55	-----	3.9	4.12	17.93	4.15	22.08	.232	.154	.013	-----
106-----	8	5	14.7	6	37.66	33.73	.82	5.79	.99	-----	6.3	4.32	17.04	4.38	21.42	.256	.291	.023	-----
107-----	6	0	-----	26	-----	-----	-----	-----	-----	-----	-----	4.58	24.88	2.18	27.03	.088	-----	-----	21.4
108-----	8	0	17.4	6	34.51	28.70	.88	8.42	2.44	.00	7.7	4.42	20.88	4.45	25.33	.213	.319	.045	20.0
109-----	7	1	-----	26	-----	-----	-----	-----	-----	-----	-----	4.02	26.45	7.68	34.13	.290	-----	-----	12.5
110-----	9	0	17.0	5	37.06	29.63	.87	8.68	1.30	-----	5.5	4.28	26.44	6.25	32.69	.236	.275	.041	-----

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
111.....	1957	-----	Natural summer blend-honeydew.	Tulip tree, sumac, honeydew.	None.....	Liquid.....	Bruce Anderson, Chatham, Va....	Chatham.
112.....	1957	-----	Natural summer blend.	Tulip tree, W. clover, sumac, honeydew.	do.....	do.....	do.....	Chatham.
113.....	1957	Aug. 1.....	do.....	Mountain flowers	130° for 20 min., 22" vacuum.	do.....	W. E. Lyman, Greenwich, N.Y....	Hamilton County.
114.....	1957	Aug. 1.....	do.....	Mountain flowers	None.....	do.....	do.....	Hamilton County.
115.....	1957	Summer.....	do.....	Wild flowers	do.....	do.....	J. O. Sherfy, Gravette, Ark.....	Benton County.
116.....	1957	Aug. 15.....	do.....	do.....	Slightly.....	do.....	D. G. Greenler, Toledo, Ohio.....	Sandusky and Wood Counties.
117.....	1957	September.....	do.....	Sweet and other clovers; mixed flowers Unstrained.	None.....	Solid granulation.....	W. S. Sundberg, Fergus Falls, Minn.	Ottertail County.
118.....	1957	do.....	do.....	Sweet and white clover; mixed flowers.	do.....	do.....	do.....	Do.
119.....	1957	July.....	do.....	Cotton, clover, mesquite; typical summer honey.	Mild.....	Liquid.....	O. L. Tolman, Cotulla, Tex.....	Maverick County.
120.....	1957	Aug. 28.....	do.....	Clover, basswood alfalfa, goldenrod & boxelder honeydew no surplus after early Aug.	do.....	Soft granulation.....	Carroll E. Stone, Hutchinson, Minn.	McLeod County.
121.....	1957	-----	do.....	do.....	Below 100°.....	Liquid.....	James J. Sullivan, Minneapolis, Minn.	Le Center.
122.....	1956	Mid-September.	do.....	Wild raspberry white clover, fall chickweed.	do.....	Crystals.....	Richard H. Washburn, Palmer, Alaska.	Palmer.
123.....	1957	do.....	do.....	do.....	do.....	do.....	do.....	Do.
124.....	1957	-----	do.....	Clovers & July woods flowers.	160° for 20 min.	Granulated.....	M. J. Ambrose, Winslow, Me.....	Kennebec Valley.
125.....	1956	Feb. 1957.....	Natural summer and fall blends.	Gallberry, Spanish needle & palmetto.	do.....	Liquid.....	Millard Coggsall, Minneola, Fla.	South Lake County.
126.....	1956	-----	Fall blend	Sp. needle, heartsease, goldenrod, aster from strip coal mine.	130°.....	do.....	L. M. Leiper, Belleville, Ill.....	Belleville.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			<i>Percent</i>	<i>Month</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		<i>Meg./kg</i>	<i>Meg./kg</i>	<i>Meg./kg</i>		<i>Percent</i>	<i>Percent</i>	
111.....	10	0	15.3	5	33.66	25.07	1.15	11.33	4.05	0.00	9.4	5.30	32.55	3.87	33.42	0.027	0.615	0.042	27.8
114.....	6	2	17.1	9	40.68	31.65	.91	7.08	1.33	-----	1.2	3.90	25.63	7.66	33.29	.299	.183	.036	13.6
116.....	4	1	17.9	14	38.47	32.65	2.34	5.97	1.14	.79	.7	3.70	22.73	9.90	32.63	.436	.077	.045	16.2
117.....	1	4	17.5	15	38.13	33.38	1.93	5.78	.97	-----	2.3	3.83	14.17	4.52	18.69	.319	.059	.025	-----
118.....	2	1	17.9	15	37.87	32.93	.83	6.21	1.26	.66	2.3	3.95	16.88	6.02	22.70	.368	.104	.027	-----
119.....	5	6	18.0	18	38.42	34.60	1.58	6.33	.69	-----	.4	3.82	25.72	11.15	36.54	.434	.104	.024	-----
120.....	3	2	17.8	17	38.98	32.94	1.43	6.47	1.32	.00	1.1	4.10	13.09	3.05	16.14	.233	.098	.026	-----
121.....	2	2	20.4	16	38.00	32.08	.96	7.39	1.10	-----	.1	3.79	16.89	4.20	21.09	.249	.075	.040	22.6
122.....	6	1	16.6	30	38.79	29.31	.97	9.59	2.17	-----	2.6	4.05	12.42	2.95	15.37	.238	.065	.032	-----
123.....	4	1	14.4	18	39.59	31.22	.75	9.86	2.67	-----	2.2	4.10	13.78	4.95	18.72	.360	.101	.033	-----
124.....	7	5	18.8	27	35.70	33.90	1.98	5.88	2.32	.00	1.4	4.10	24.11	4.82	28.93	.200	.180	.067	-----
Ave., 100-124.	6	2	17.2	15	37.94	31.40	1.11	7.65	1.68	-----	3.0	4.03	21.60	5.65	27.23	.269	.182	.037	18.2
125.....	9	0	17.8	11	37.79	29.69	1.22	8.43	1.21	-----	3.9	3.89	31.63	14.28	45.91	.451	.221	.053	6.8
126.....	8	0	16.7	17	39.13	29.16	.76	9.54	.62	-----	4.1	4.95	19.92	.27	20.18	.014	.361	.048	19.4
Ave., 125-126.	9	0	17.3	14	38.46	29.43	.99	8.99	.92	-----	4.0	4.15	25.78	7.28	33.05	.233	.291	.051	13.1

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
127	1956	Late September.	Natural season blend.	Nearly everything		Liquid	L. C. Lueddecke, St. Louis, Mo.	South St. Louis.
128	1956	October	do.		150° for 20 min.	do.	F. R. Buchanan, Whitemarsh, Pa.	Whitemarsh.
129	1956		Natural season blend.	Unstrained		Partly granulated	H. C. Walden, Tulsa, Okla.	Tulsa County.
130	1956	Oct. 5	do.	Alfalfa, yellow star thistle, tarweed, blue curl.	120°	Liquid	Jess Gentry, Oakdale, Calif.	Stanislaus County.
131	1956		do.		None	Granulated	H. A. Schaefer, Osseo, Wis.	Osseo.
132	1956	Late October.	do.		do.	do.	Paul S. Zeigler, Bethel, Pa.	Bethel.
133	1956	Oct. 1956	do.		120°	Liquid	Clarence Munroe, E. Providence, R.I.	East Providence.
134	1956	Nov. 1956	do.	Dandelion, tulip tree, alfalfa, alsike clover, sumac.	100° for 18 hr.	do.	Paul L. Holcombe, Lambertville N.J.	Lambertville area.
135	1957	Sept. 15	do.	Sweet clover alfalfa, wild flowers and Canada thistle.		Partly granulated	Wallace Irving, Bonners Ferry, Idaho.	Boundary County.
136	1957	November	do.			Liquid	N. B. Cook, Collegeville, Pa.	Collegeville.
137	1956		Natural blend		150°	do.	E. C. Bessonnet, Donaldsonville, La.	Donaldsonville.
138	1956		do.			do.	G. V. Palmrose, Beaverton, Oreg.	Tualatin Valley.
139	1956		do.		142° for 30 min.	Coarse granulation	A. R. Dean, Pittsburgh, Pa.	Pittsburgh.
140	1956	Fall	do.		130°	Crystals	B. M. Bosworth, Barrington, R.I.	Barrington.
141	1956		Natural blend	Swamp sources	None	Granulated	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
142	1957		do.			Liquid	Howard Day, Honesdale, Pa.	Honesdale.
143	1957		do.		None	Crystals	Cecil E. Keiter, Monette, Ark.	Monette.
144	1957	April 15	do.	Desert blend		Few crystals	E. S. Foote, Poway, Calif.	North West Anza Desert, San Diego County.
145	1957		do.			Granulated	Roy D. Brown, Del Rio, Tenn.	Del Rio.
146	1957	November	do.			Soft granulation	N. B. Cook, Collegeville, Pa.	Schwenksville.
147	1956		Blueberry			Granulated	Walter Witherell, Westhampton, Mass.	Westhampton.
148	1957		Blueberry-huckleberry.	Early honey		Partly granulated	Frank Fekel, Vineland, N.J.	Hammonton.
149	1956	September	Blue curls		None	Granulated	L. G. Gear, Los Banos, Calif.	Los Banos.
150	1957	do.	Bluevine	From crushed virgin combs. (Has a dense turbid layer on top)	do.	Soft granulation	Carl Kalthoff, Lexington, Mo.	Lafayette and Saline Counties.
151	1957	August	Boneset			Few crystals	M. V. Cogshall, Minneola, Fla.	Hendry County.
152	1956	Sept. 1	Buckwheat			Liquid	James S. Messner, Bareville, Pa.	Tioga County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg	Meq./kg	Meq./kg		Percent	Percent	
127-----	10	1	15.8	10	39.79	29.91	1.05	7.51	2.30	-----	3.6	4.01	33.98	11.67	45.65	0.344	0.188	0.133	39.0
128-----	7	1	21.8	8	35.52	29.48	.49	7.09	1.32	-----	4.3	3.88	28.49	7.82	36.31	.275	.200	.060	22.4
129-----	6	2	19.0	10	37.42	30.69	1.03	6.68	1.44	-----	3.7	3.81	29.22	9.12	38.35	.312	.156	.054	15.0
130-----	5	9	16.2	11	38.47	34.41	1.02	6.05	1.10	-----	2.7	4.10	23.60	14.80	38.40	.627	.159	.052	27.0
131-----	5	5	18.3	11	39.59	33.53	.53	5.03	1.15	-----	1.9	3.85	25.88	10.56	36.44	.406	.135	.042	33.3
132-----	9	1	18.6	12	34.25	28.16	.88	7.84	4.08	-----	6.2	4.16	39.22	7.87	47.09	.200	.084	.027	-----
133-----	7	1	-----	10	-----	-----	-----	-----	-----	-----	-----	4.23	21.13	6.96	28.09	.328	-----	-----	8.3
134-----	10	1	17.4	14	33.25	28.50	.92	10.63	2.27	-----	7.0	4.68	36.41	3.00	39.41	.082	.447	.053	22.2
135-----	4	3	13.4	8	39.88	31.98	3.21	7.81	1.41	.00	2.3	3.85	13.79	2.30	16.09	.167	.054	.025	-----
136-----	10	0	18.5	11	32.46	29.59	1.11	8.00	3.24	.75	6.4	4.05	39.88	7.92	47.80	.199	.447	.099	24.0
Ave., 127-136	7	2	17.7	11	36.74	30.69	1.14	7.40	2.03	-----	4.2	4.01	29.16	8.20	37.36	.294	.208	.061	23.9
137-----	8	1	18.5	12	36.08	30.40	.84	8.42	1.32	-----	4.8	4.21	25.20	7.23	32.43	.287	.309	.049	25.2
138-----	9	0	15.2	12	28.98	23.58	1.36	15.55	6.36	.70	8.3	4.36	36.57	7.33	43.90	.201	.472	.065	37.5
139-----	8	4	-----	10	-----	-----	-----	-----	-----	-----	-----	4.08	28.80	9.14	37.94	.317	-----	-----	30.0
140-----	8	3	-----	9	-----	-----	-----	-----	-----	-----	-----	3.96	23.59	9.65	33.24	.408	-----	-----	-----
141-----	8	1	18.0	33	38.13	29.69	.67	8.86	1.34	.40	2.9	4.54	15.71	1.88	17.60	.120	.183	.045	-----
142-----	3	1	-----	1	-----	-----	-----	-----	-----	-----	-----	3.88	14.98	5.68	20.66	.379	-----	-----	25.5
143-----	4	5	19.0	7	38.38	32.55	.79	5.41	1.13	-----	2.7	4.10	27.83	6.62	34.36	.234	.230	.043	27.9
144-----	4	2	17.3	15	41.50	30.46	.64	6.61	.95	-----	.81	3.60	24.62	10.15	34.77	.412	.114	.058	30.9
145-----	9	1	-----	19	-----	-----	-----	-----	-----	-----	-----	3.99	30.51	8.70	39.21	.285	-----	-----	-----
146-----	10	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	.490	.092	-----
Ave., 137-146	7	2	17.6	13	36.61	29.34	.86	8.97	2.22	-----	4.1	4.01	25.31	7.36	32.68	.294	.300	.059	29.5
147-----	8	2	17.4	16	37.20	31.08	.79	9.09	.83	-----	3.6	4.36	16.36	4.92	21.29	.301	.163	.059	-----
148-----	9	0	17.9	9	38.52	29.89	.75	8.23	1.07	-----	3.6	4.05	34.40	11.10	45.49	.323	.271	.024	-----
149-----	5	9	16.1	11	30.91	40.75	1.34	5.54	1.13	-----	4.2	3.60	28.10	13.73	41.83	.489	.097	.044	-----
150-----	4	0	16.1	16	35.35	28.34	2.63	7.20	5.30	.35	4.7	3.90	15.84	6.99	22.83	.441	.103	.040	-----
151-----	8	1	20.6	16	40.01	28.65	1.00	6.68	1.03	-----	2.0	4.00	32.45	7.20	39.66	.222	.142	.119	25.6
152-----	12	9	16.2	12	37.05	33.38	.57	5.69	1.18	-----	5.9	3.98	46.29	7.94	54.23	.172	.118	.124	46.2

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
153.....	1956	.....	...do.....	In comb.....	None.....	Partly granulated...	L. W. Sundberg, Richville, Minn.	Richville, Ottertail County.
154.....	1956	September.....	...do.....	.....	135°.....	Liquid.....	H. R. Swisher, Springfield, Ohio	Clark County.
155.....	1956	August.....	...do.....	.....	.....	...do.....	Leonard M. Llewellyn, Laurel, Md.	Garrett County.
156.....	1957	Sept. 2.....	...do.....	.....	None.....	Partly granulated...	Mrs. Phil Chaffin, St. Cloud, Minn.	Sherburne County.
157.....	1956	.....	Buckwheat-gold-enrod.	.....	"Very low".....	Few crystals.....	J. H. Lindner, Cumberland, Md.	Garrett County.
158.....	1956	July 25.....	Buckwheat, wild.	Strained.....	110°.....	Partly granulated...	William Ross, Valyermo, Calif.	Los Angeles County.
159.....	1956	.....	...do.....	.....	None.....	...do.....	R. W. Taylor, Alhambra, Calif.	Soledad Canyon.
160.....	1956	July.....	...do.....	.....	140°.....	Granulated.....	Hood Littlefield, Pasadena, Calif.	Inyo County.
161.....	1957	July 1.....	...do.....	.....	.....	...do.....	E. S. Foote, Poway, Calif.	San Diego County.
162.....	1957	.....	Buckwheat, wild avocado.	.....	.....	Crystals.....	C. L. Morris, Vista, Calif.	Do.
163.....	1957	June.....	Cantaloupe.....	Unstrained.....	None.....	Liquid.....	J. Herman Larkin, Laredo, Texas.	Laredo.
164.....	1957	.....	Cape vine.....	.....	.....	...do.....	A. T. Uzzell, Moore Haven, Fla.	Moore Haven.
165.....	1956	.....	Carrot, wild-clover.	Core sample 60 # cans, 56-60° storage.	None.....	Granulated.....	H. J. Moulton, Portland, Oreg.	North Willamette Valley.
166.....	1956	.....	Cherry, wild-private.	.....	.....	Liquid.....	L. H. Little, Shelbyville, Tenn.	Shelbyville.
167.....	1956	.....	Chinquapin.....	In comb.....	None.....	...do.....	Wilbur Murray, Lake City, Fla.	Lake City.
168.....	1956	September.....	...do.....	...do.....	...do.....	...do.....	C. G. Wenner, Glenn, Calif.	Mt. Lassen, 5,500-7,000 ft.
169.....	1957	...do.....	...do.....	Elevation 6,000 ft.....	120°.....	Solid granulation.....	...do.....	Mt. Lassen area, Shasta County.
170.....	1956	.....	Clover, alsike.....	Drained from chunk comb.	None.....	.....	Robert Banker, Cannon Falls, Minn.	Cannon Falls.
171.....	1956	July.....	...do.....	.....	135°.....	Liquid.....	H. R. Swisher, Springfield, Ohio	Madison County.
172.....	1957	.....	...do.....	6,500 ft. elevation.....	.....	Granulated.....	S. J. Watkins, Fruita, Colo.	Steamboat Springs.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meg./kg	Meg./kg	Meg./kg		Percent	Percent	
153.....	8	2	17.8	12	35.26	28.54	0.77	6.92	4.51	-----	6.2	4.17	32.73	8.79	41.52	0.268	0.307	0.030	31.6
154.....	12	1	19.0	14	37.06	31.09	1.41	7.51	1.03	-----	2.9	3.93	32.17	8.38	40.55	.158	.031	-----	-----
155.....	10	0	15.4	15	30.81	23.94	.61	11.41	3.85	-----	14.0	4.38	38.18	4.42	42.60	.158	.472	.050	-----
156.....	7	0	22.9	8	36.30	30.33	.56	6.62	.77	-----	2.5	3.70	26.00	5.41	31.41	.208	.066	.083	-----
Ave., 152-156.	10	2	18.3	12	35.30	29.46	.78	7.63	2.27	-----	4.3	3.97	35.07	6.99	42.06	.213	.224	.064	38.9
157.....	12	6	18.4	13	38.22	33.91	.66	4.88	1.01	-----	2.9	3.99	39.09	8.15	47.24	.208	.226	.030	-----
158.....	6	1	15.7	13	39.15	30.79	.89	8.49	.91	-----	4.1	4.08	22.77	6.80	29.57	.298	.232	.058	33.0
159.....	5	4	16.1	14	41.30	29.96	.87	6.69	.97	-----	4.1	3.88	26.50	4.95	31.45	.186	.088	.048	25.0
160.....	6	5	15.7	14	39.74	32.21	.84	6.15	.72	-----	4.6	4.04	23.18	4.70	27.88	.202	.082	.043	-----
161.....	6	2	17.5	12	38.67	29.02	.57	7.52	.71	-----	6.0	3.71	28.53	10.87	39.40	.381	.143	.067	-----
Ave., 158-161.	6	3	16.3	13	39.72	30.50	.79	7.21	.83	-----	4.7	3.90	25.25	6.83	32.08	.267	.136	.054	29.0
162.....	8	1	17.7	16	37.72	28.11	.91	9.61	1.24	-----	4.7	4.01	37.45	8.25	45.70	.220	.295	.094	-----
163.....	7	8	15.4	11	37.00	34.51	2.85	5.41	1.10	.00	3.7	3.80	31.28	10.20	41.57	.326	.203	.021	8.1
164.....	5	4	22.3	6	36.05	31.61	.45	5.18	.59	-----	3.5	3.93	22.28	6.61	28.89	.298	.119	.017	24.0
165.....	9	7	16.4	31	33.96	30.47	1.02	11.15	3.04	-----	4.0	4.20	31.66	10.43	42.09	.329	.378	.060	-----
166.....	4	2	16.6	9	37.40	32.15	1.77	6.93	1.62	-----	3.5	4.02	15.24	5.90	21.14	.387	.130	.038	15.0
167.....	11	0	17.3	9	34.79	22.04	1.18	15.98	1.72	-----	7.0	5.26	19.47	3.71	23.18	.190	.943	.017	19.0
168.....	10	0	14.5	12	31.67	21.78	.71	10.71	8.49	-----	12.1	5.22	23.97	1.25	25.22	.052	.721	.031	31.6
169.....	10	4	15.6	16	34.43	27.96	.77	10.13	4.17	-----	6.9	4.65	42.27	5.11	47.38	.121	.618	.107	-----
Ave., 167-169.	10	1	15.8	12	33.63	23.93	.89	12.27	4.79	-----	5.3	4.95	28.57	3.36	31.93	.121	.761	.052	25.3
170.....	4	2	16.6	12	38.37	31.03	1.53	7.59	1.58	-----	3.3	3.86	17.91	10.06	27.97	.562	.090	.032	17.6
171.....	3	1	18.2	16	39.09	33.09	1.70	5.94	.95	-----	1.0	3.73	17.57	7.72	25.29	.439	.049	.017	-----
172.....	1	1	15.6	11	40.07	28.03	.98	8.84	2.13	-----	4.3	3.91	11.97	3.80	15.77	.318	.062	.027	-----
Ave., 170-172.	3	1	16.8	13	39.18	30.72	1.40	7.46	1.55	-----	2.9	3.83	15.82	7.19	23.01	.440	.067	.025	-----

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments 1	Producer's heating, F.	Condition on receipt	Name and address of producer	Area produced
173.	1957	Sept. 1.	Clover, alsike-al-falfa.	Unstrained; some late clover.	None	Solid granulation	Oliver Petty, Albany, Oreg.	Jefferson County.
174.	1957		Clover, alsike-sweet clover	From river valley	do.	Liquid	W. H. Freeman, Ft. Covington, N. Y.	Near St. Lawrence River.
175.	1957		Clover, alsike-white clover.		do.	Crystals	Thomas A. Ott, Columbia City, Ind.	Noble County.
176.	1956	May.	Clover, crimson.	Reseeding	None	$\frac{1}{8}$ " crystals	J. H. Chardreau, Jr., Titton, Ga.	Dougherty County.
177.	1956		do.		None	Liquid	Allen Bostick, Quincy, Fla.	Quincy, Dougherty County.
178.	1957	May.	do.		do.	do.	J. H. Chardreau, Jr., Titton, Ga.	Albany, Dougherty County.
179.	1957		do.	In comb	None	Liquid	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
180.	1956		Clover, crimson-fallberry.	Also some vetch	do.	Crystals	do.	Do.
181.	1957	Summer	Clover, crimson-top clover.			Liquid	J. O. Sherry, Gravette, Ark.	Benton County.
182.	1957		Clover, crimson-top tree.			do.	John Bean, Leoma, Tenn.	Leoma.
183.	1957	June 12.	Clover, hubdam.	Unstrained early crop	None	do.	Roy S. Weaver, Jr., Navasota, Texas.	College Station, Brazos County.
184.	1957	July 1	do.	Unstrained midseason dry season.	do.	do.	do.	McGregor, McLennan County.
185.	1957	July 31.	do.		do.	Crystals	Emilian Mensick, LaGrange, Texas.	Fayette County.
186.	1956	June 15.	Clover, hubdam-natural spring blend.	Salt cedar, arrow weed.	120°	Granulated	Maylin Beatty, Westmorland, Calif.	North end, Imperial Valley.
187.	1957		Clover, red birds-foot trefoil.	WSC Apiary, Montgomery clover.		Soft granulation.	Carl Johansen, Pullman, Wash.	Pullman.
188.	1957	July 15.	Clover, straw-berry-white clover.	About 90% straw-berry clover.		Solid granulation	Charles G. Becker, Outlook, Wash.	Yakima Valley.
189.	1956		Clover, sweet.	Unstrained.		Liquid	Lynn H. Beard, Tulsa, Okla.	Tulsa County
190.	1956	July.	Clover, sweet.	In comb	None	do.	Leonard M. Llewellyn, Laurel, Md.	McCook, Allegany County.
191.	1956		do.	From strip coal mine.	130°	do.	L. M. Lapeer, Belleville, Ill.	Belleville.
192.	1956	July.	do.		None	do.	Arthur G. Strang, Silver Spring, Md.	Fauquier County, Va.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melazolose	Undetermined	pH	Free acid	Lactic tone	Total acid	Lactic tone free acid	Ash	Nitrogen	Dia-stase
173-----	5	9	Percent 15.6	Month 17	Percent 38.71	Percent 33.88	Percent 1.69	Percent 7.05	Percent 0.85	Percent -----	Percent 2.2	3.75	Meg./kg 29.39	Meg./kg 11.30	Meg./kg 40.69	0.385	Percent 0.087	Percent 0.076	-----
174-----	1	2	15.6	6	37.16	30.14	4.37	7.35	1.99	.00	3.4	3.88	10.13	4.34	14.47	.428	.084	.021	18.2
175-----	4	4	18.2	13	38.25	33.58	1.68	5.50	.82	-----	2.0	3.40	28.26	14.36	42.62	.508	.081	.047	-----
176-----	4	4	19.1	14	39.02	32.81	.73	6.26	1.14	-----	.9	3.83	29.64	7.49	28.13	.364	.080	.036	18.2
177-----	3	1	17.4	13	38.72	29.31	.85	10.27	1.43	-----	4.0	3.80	13.73	6.93	20.66	.506	.086	.030	24.0
178-----	1	0	15.8	10	39.66	30.46	.77	9.22	1.68	-----	2.4	3.73	13.40	3.35	20.75	.347	.040	.027	34.9
179-----	1	1	17.2	22	37.45	30.90	1.29	8.61	2.26	-----	2.3	3.63	12.81	4.38	17.19	.342	.050	.021	16.7
Ave., 176-179.	2	2	17.4	15	38.21	30.87	.91	8.59	1.63	-----	2.4	3.74	15.65	6.04	21.68	.380	.057	.029	22.7
180-----	3	3	18.4	31	37.39	31.51	.86	8.77	1.66	.72	.7	3.71	12.17	3.02	15.19	.248	.035	.037	-----
181-----	4	0	19.9	10	36.94	32.90	1.96	4.94	1.25	.00	2.1	3.42	30.67	15.37	46.04	.501	.079	.050	19.4
182-----	8	0	18.0	15	35.30	22.89	1.04	14.94	3.01	.00	4.8	4.71	20.51	2.82	23.36	.138	.449	.031	17.6
183-----	1	2	19.8	6	38.96	32.65	.62	5.18	.58	-----	2.2	3.78	19.15	8.46	27.61	.442	.096	.004	-----
184-----	3	3	17.7	5	39.65	33.99	.86	5.99	.74	-----	1.1	3.91	13.65	3.06	16.71	.369	.039	.011	-----
185-----	4	5	17.0	13	37.45	33.63	1.09	7.51	.91	-----	2.4	3.80	24.06	13.30	37.36	.553	.120	.037	-----
Ave., 183-185.	2	3	18.2	8	38.69	33.42	.86	6.23	.74	-----	1.9	3.83	18.95	8.94	27.89	.455	.092	.017	-----
186-----	7	9	15.2	14	39.26	34.40	2.01	6.11	.70	-----	2.3	3.97	21.64	8.37	30.01	.385	.126	.058	-----
187-----	1	2	16.8	14	38.81	30.83	.68	8.84	1.08	-----	3.0	3.99	11.79	2.56	14.35	.217	.063	.030	-----
188-----	6	5	17.6	18	39.88	33.86	1.59	5.60	.91	-----	.6	3.65	31.98	14.80	46.77	.463	.087	.051	-----
189-----	5	1	17.8	9	38.63	30.12	1.01	8.17	1.94	-----	2.3	3.88	22.71	6.85	29.56	.301	.073	.052	18.8
190-----	4	0	17.3	16	36.59	26.36	.73	12.90	1.63	.00	4.5	4.39	13.86	6.77	20.13	.507	.103	.029	11.0
191-----	4	2	17.3	22	38.30	33.86	1.95	5.83	.73	.57	1.4	3.87	17.89	7.14	25.03	.399	.063	.065	7.0
192-----	5	0	18.4	27	36.84	26.88	.71	11.86	1.57	-----	3.7	3.69	17.42	4.32	21.74	.248	.071	.029	23.6
Ave., 189-192.	5	1	17.7	18	37.59	29.30	1.10	9.69	1.47	-----	3.0	3.82	17.84	6.27	24.11	.364	.099	.036	15.1

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
138-----	1957	August-----	Clover, sweet-----	Black loam soil-----	None-----	Liquid-----	Clarence Beck, Sioux Falls, S. D.	Sioux Falls.
144-----	1957	July-----	do-----	-----	-----	Granulated-----	Walter L. Guntren, Storm Lake, Iowa	Buena Vista County.
195-----	1957	August-----	do-----	-----	None-----	Liquid-----	Andrew McShaw, Transfer, Pa.	Lawrence County.
196-----	1957	July 4-----	-----	-----	-----	do-----	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
197-----	1957	Spring-----	do-----	Unstrained-----	do-----	Crystals-----	L. E. Hazen, Stillwater, Okla.	Stillwater.
198-----	1956	July 30-----	Clover, sweet-alfalfa-----	-----	120°-----	Granulated-----	Roscoe Geisel, Augusta, Mont.	Sun River.
199-----	1956	Aug. 10-----	do-----	-----	120°-----	do-----	do-----	Do.
200-----	1956	Aug. 15-----	-----	First cutting alfalfa; mostly yellow sweet clover-----	None-----	do-----	Lester Hall, Livingston, Mont.	Paradise Valley.
201-----	1956	Late August-----	do-----	-----	150°-----	Liquid-----	P. J. Pooley, Mitchell, S. D.	Mitchell.
202-----	1956	Aug. 1-----	do-----	-----	140°-----	do-----	Earl Barnes, Dillon, Mont.	Dillon.
203-----	1957	Sept. 10-----	do-----	-----	None-----	do-----	E. O. Rauchbuss, Powell, Wyo.	Park County.
204-----	1957	July-----	do-----	-----	-----	Crystals-----	John M. Osborn, Buffalo, Wyo.	Johnson County.
205-----	1957	-----	Clover, white sweet-alfalfa-----	-----	-----	Partly granulated-----	Carol W. Mahns, Red Oak, Iowa.	Red Oak.
206-----	1957	Sept. 14-----	Clover, sweet-alfalfa-----	Unstrained-----	None-----	do-----	J. F. Meade, Pablo, Mont.	Lake County.
207-----	1957	Aug. 26-----	do-----	-----	do-----	Solid granulation-----	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
208-----	1957	October-----	do-----	-----	140°-----	Liquid-----	I. C. Andersen, Lake Benton, Minn.	Lincoln County.
209-----	1957	August-----	Clover, sweet-basswood-----	Sandy and clay soil-----	None-----	Granulated-----	Walter L. Guntren, Storm Lake, Iowa.	Buena Vista County.
210-----	1957	Aug. 11-----	do-----	From river basin-----	130° for 15 min-----	-----	Charles B. Crispin, Grimes, Iowa.	Garlock, Polk County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Unidentified	pH	Free acid	Lactic acid	Total acid	Lactic/Free acid	Ash	Nitrogen	Dia-stase
183-----	0	6	Percent 17.8	Month 5	Percent 38.16	Percent 33.14	Percent 1.63	Percent 5.64	Percent 0.83	Percent 0.83	Percent 2.8	4.01	Meg./kg 12.07	Meg./kg 3.92	Meg./kg 13.99	0.324	Percent 0.044	Percent 0.024	22.6
184-----	1	2	18.7	6	39.26	33.11	1.64	5.29	0.87	0.99	2.8	3.90	13.33	3.99	13.32	.449	.051	.025	18.9
185-----	6	2	18.7	9	38.68	33.93	1.83	4.46	.58	1.25	1.6	3.42	42.97	15.25	58.22	.355	.141	.072	18.9
186-----	6	0	16.0	15	38.84	30.00	1.82	8.63	1.84	1.78	3.9	3.85	19.41	3.78	23.19	.286	.097	.042	24.6
187-----	6	1	17.2	22	36.24	30.82	3.41	6.97	2.60	1.21	1.6	3.58	16.83	6.76	23.59	.402	.022	.033	---
Ave., 183-197.	4	2	17.7	12	38.24	32.80	1.67	6.20	1.34	---	2.3	3.69	20.92	3.77	28.46	.366	.071	.039	20.0
Ave., 189-197.	4	2	17.7	15	37.95	30.97	1.41	7.75	1.40	---	2.6	3.77	19.55	6.98	26.53	.365	.084	.038	18.1
198-----	0	7	16.8	7	39.61	34.36	3.72	4.83	.88	---	0	4.02	7.60	3.38	10.98	.446	.033	.014	8.2
199-----	0	8	16.7	6	40.11	35.10	2.38	4.23	.85	---	.7	4.00	7.73	3.33	11.03	.429	.043	.019	7.8
200-----	2	9	16.2	7	39.03	35.32	1.56	5.35	1.03	---	1.3	3.99	6.21	3.43	9.21	.372	.069	.026	10.2
201-----	4	6	16.8	12	38.80	34.46	2.90	5.80	.84	---	.4	3.74	12.62	3.76	18.27	.435	.017	.025	6.5
202-----	1	9	---	12	---	---	---	---	---	---	---	3.82	11.49	5.13	16.62	.447	---	---	8.7
Ave., 198-202.	2	8	16.6	9	39.39	34.81	2.64	5.05	.90	---	.6	3.90	9.71	4.21	13.92	.430	.026	.021	8.5
203-----	0	2	17.6	6	38.91	33.94	2.43	5.40	.84	---	.9	3.60	15.63	6.26	21.89	.401	.043	.023	---
204-----	0	1	14.9	8	39.08	33.11	3.30	7.49	1.07	.00	2.0	4.10	9.77	1.30	20.07	.153	.028	.016	9.9
205-----	4	4	18.3	8	39.74	33.02	1.33	5.71	.78	---	1.1	3.65	20.83	8.41	29.24	.494	.060	.034	---
206-----	3	5	15.0	6	41.23	33.25	1.28	6.68	.99	.00	1.3	3.93	17.57	8.28	27.75	.471	.084	.045	---
207-----	2	3	16.2	13	38.89	33.89	2.56	6.01	.79	---	2.8	3.80	17.36	6.19	23.55	.380	.081	.039	---
208-----	3	3	18.0	16	38.19	33.89	2.56	5.77	.84	---	.8	3.68	17.22	6.15	23.37	.357	.049	.034	---
Ave., 203-208.	2	3	16.7	10	39.34	33.38	2.03	6.18	.89	---	1.5	3.74	16.44	6.10	23.02	.354	.038	.032	---
Ave., 198-208.	2	5	16.7	9	39.36	33.95	2.27	5.73	.89	---	1.2	3.82	13.39	5.24	18.89	.388	.045	.028	8.8
209-----	2	1	18.2	8	39.03	32.55	.57	6.31	1.00	---	2.3	4.09	15.24	6.33	21.57	.415	.121	.030	---
210-----	4	2	18.8	9	38.83	33.23	.88	5.81	1.40	---	1.0	4.01	20.11	5.68	25.78	.282	.180	.067	20.0
Ave., 209-210.	3	2	18.5	9	38.93	32.89	.73	6.06	1.20	---	1.7	4.05	17.08	6.01	23.68	.349	.151	.049	---

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments 1	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
211.....	1957	Sept. 3.....	Clover, sweet-blue yervath.	Possible honeydew unstrained.	None.....	Liquid.....	F. Q. Bunch, Welch, Minn.....	Welch.
212.....	1957	Aug. 10.....	do.....	Processed honey for sale.	158°.....	do.....	do.....	Do.
213.....	1957	.....	Clover, sweet-natural summer blend.	.....	None.....	do.....	George W. Stone, Niagara Falls, N. Y.	Niagara Falls.
214.....	1957	August.....	Clover-vetch.....	Strained (A & M Apiary).	.....	do.....	G. A. Bieberdorf, Stillwater, Okla.	Stillwater.
215.....	1957	.....	Clover, white sweet.	.....	.....	Beginning fine granulation.	J. D. Brown, Gardner, Ill.....	Gardner.
216.....	1957	August.....	Clover blend.....	Clover, white sweet, alsike and ladino.	.....	Soft granulation.....	Lloyd A. Lindenfelsner, Tremont, Ill.	Tremont.
217.....	1957	.....	Clover, yellow sweet.	Trace of alfalfa.....	.....	Partly granulated.....	Frank O. Lucore, St. Sioux City, Neb.	South Sioux City.
218.....	1957	Aug. 16.....	do.....	.....	.....	Granulated.	A. B. Carlson, Hinsdale, Mont.....	Valley County.
219.....	1957	July 25.....	do.....	.....	None.....	Very hard, granulated.	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
220.....	1957	.....	Clover, yellow sweet-mustard.	.....	.....	Partly granulated.....	C. J. Clark, Sun River, Mont.....	Cascade.
221.....	1956	Late July.....	Clover, sweet, mixed.	KSC Apiary.....	130°.....	Liquid.....	R. L. Parker, Manhattan, Kans.....	Manhattan.
222.....	1956	July.....	Clover, yellow and white sweet.	Unstrained, stored at 60°-70°.	120°.....	do.....	Harry B. Rooke, Eureka, Ill.....	Livingston County.
223.....	1957	Aug. 15.....	Clover, white and yellow sweet.	.....	.....	do.....	Thomas A. Peterson, St. Paul, Minn.	Dakota County.
224.....	1957	.....	do.....	Direct from extractor.....	None.....	Beginning to granulate.	A. P. Sturtevant, Laramie, Wyo.....	Laramie.
225.....	1957	.....	Clover, yellow and white sweet.	.....	120°.....	Liquid.....	Marvin Wahl, Chenoa, Ill.....	Chenoa.
226.....	1957	.....	Clover, white and yellow sweet-heartsease.	.....	.....	do.....	Ralph Wilson, Belmont, Iowa.....	Wright County.
227.....	1957	July.....	do.....	.....	120°.....	do.....	Harry B. Rooke, Eureka, Ill.....	Livingston County.
228.....	1957	Oct. 3.....	Clover, blend-heartsease.	.....	None.....	do.....	Earl C. Robinson, Oselwein, Iowa.	Fayette County.
229.....	1957	Aug. 1.....	Clover, white and yellow sweet-white clover.	White, white and yellow sweet and alsike clovers.	10 min.....	Crystals.....	Ray Silver, Logansport, Ind.....	Clay Township, Cass County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups—Continued*

Sample No.	Color ¹	Grain- lition ¹	Mois- ture	Age	Levu- lose	Dex- trose	Sucrose	Malt- ose	Higher sugars	Molecu- lose	Un- de- ter- mined	pH	Free acid	Lac- tone	Total acid	Lac- tone/ free acid	Ash	Nitro- gen	Dia- stase
211.....	2	3	Percent 17.8	Month 5	Percent 36.95	Percent 31.08	Percent 0.92	Percent 7.55	Percent 1.27	Percent .99	Percent 4.4	4.02	Meg./lb 17.60	Meg./kg 4.61	Meg./kg 22.21	0.202 .476	Percent 0.127	Percent 0.009	16.4
212.....	1	4	17.4	5	37.91	30.27	1.36	6.03	1.27	.00	2.8	3.87	14.62	6.96	21.58				
Ave., 211-212.....	2	4	17.6	5	37.43	32.18	1.24	6.79	1.13	----	3.6	3.94	16.11	5.79	21.90	.369	.101	.014	----
213.....	4	5	18.2	5	36.73	82.35	3.27	5.04	1.49	.00	3.3	3.65	21.58	9.85	31.43	.450	.060	.034	17.9
214.....	1	2	16.4	19	37.40	30.12	1.11	8.34	2.08	----	4.6	3.80	22.80	10.43	33.16	.458	.119	.045	15.2
215.....	1	6	18.8	5	36.77	33.72	1.00	5.51	.79	.69	2.7	3.65	15.62	3.75	19.37	.240	.041	.010	20.4
216.....	4	1	17.9	16	39.27	31.63	1.47	5.61	.86	----	3.3	3.59	26.91	9.96	36.87	.370	.080	.058	----
217.....	3	4	16.6	9	39.65	31.76	.74	7.31	1.19	----	2.7	4.18	13.41	4.75	18.17	.354	.083	.026	----
218.....	1	4	14.6	11	39.78	33.53	3.49	6.48	.91	.00	1.3	3.92	10.21	9.70	19.91	.950	.043	.020	----
219.....	0	3	16.8	14	38.22	33.14	4.36	6.11	.92	----	.3	3.85	10.78	2.40	13.18	.223	.042	.021	----
Ave., 217-219.....	1	4	16.0	11	39.22	32.81	2.93	6.63	.97	----	1.4	3.96	11.47	5.62	17.09	.509	.056	.022	----
220.....	2	5	15.3	8	40.13	32.25	.78	7.75	1.06	----	2.7	4.02	10.14	4.00	14.14	.395	.055	.018	----
221.....	4	2	18.7	11	37.39	32.14	2.09	6.00	.95	----	2.7	3.89	19.12	7.57	26.69	.396	.071	.045	16.4
222.....	3	4	18.0	13	36.68	33.61	1.74	5.23	1.08	----	2.8	3.87	13.82	6.05	22.77	.438	.055	.037	20.0
223.....	2	4	18.0	6	36.50	32.04	1.56	6.17	.98	----	2.8	3.81	13.62	4.06	19.60	.408	.047	.030	----
224.....	1	8	13.6	4	40.19	32.78	2.89	3.39	1.02	.00	2.1	3.90	13.66	1.48	14.54	.113	.067	.025	10.5
225.....	3	1	18.4	7	39.00	32.95	1.89	4.87	.94	----	2.1	3.55	22.68	7.68	31.64	.352	.051	.035	30.5
226.....	0	2	20.0	7	38.17	33.69	2.25	4.17	.97	----	.5	3.81	18.69	7.83	29.52	.369	.083	.025	21.0
227.....	1	3	17.9	18	38.87	33.62	1.40	6.66	1.01	----	.8	3.74	16.43	5.08	21.51	.309	.046	.036	----
Ave., 221-227.....	2	3	18.4	9	38.11	33.29	1.71	5.50	.87	----	2.1	3.7	16.88	5.85	22.75	.339	.053	.030	19.7
228.....	4	1	17.8	14	39.01	29.21	.71	8.44	1.05	----	3.8	4.00	17.40	2.77	20.17	.159	.086	.067	31.3
229.....	5	4	16.8	14	37.73	33.82	2.44	5.38	.92	.09	2.9	3.58	25.31	11.11	36.43	.439	.073	.047	----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments 1	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
230	1966	-----	Clover, white	Heartsease flavor	150°	Liquid	E. C. Bessonet, Donaldsonville, La.	Donaldsonville,
231	1966	Early August	do	Nearly pure	Lightly heated	do	L. C. Lueddecke, St. Louis, Mo.	South St. Louis,
232	1966	Sept. 15	do	None	do	do	William A. Warren, St. Louis, Mo.	St. Louis,
233	1966	July	do	-----	do	Beginning to granulate	Otto Alpie, St. Louis, Mo.	Do.
234	1966	-----	do	-----	-----	Liquid	L. H. Little, Shelbyville, Tenn.	Chattanooga,
235	1966	June 7	do	Unstrained	None	do	George O'Neill, Haines City, Fla.	Haines City,
236	1966	-----	do	-----	do	Granulated	H. A. Schaeffer, Osseo, Wis.	Osseo,
237	1966	October	do	Strained	125°	Liquid	Earl W. Stuvam, Laurel Springs, N.J.	Camden County,
238	1966	Aug. 7	do	-----	120°	do	L. H. Townsend, Lexington, Ky.	Fayette County,
239	1967	Sept. 20	do	-----	140° (hash)	do	Evela Krulin, Warsaw, Ill.	Iowa County, Wis.
240	1967	-----	do	-----	None	Crystals	H. A. Schaeffer, Osseo, Wis.	Western Jackson County,
241	1967	July 15	do	-----	-----	Solid granulation	Charles G. Becker, Outlook, Wash.	Yakima Valley,
242	1967	-----	Clover, white-alsike	-----	-----	Liquid	Don Kloepler, Grand Ledge, Mich.	Grand Ledge,
243	1966	Before September	Clover-blue this-tle	Unstrained	90° F., 24 hrs.	Beginning to granulate	W. C. Wahl, Clayton, N. Y.	Clayton,
244	1967	-----	Clover, white-cotton	Also vetch	-----	Few crystals	Jensen's Apiaries, Macon, Miss.	Lowndes and Noxubee Counties,
245	1967	-----	do	-----	-----	Liquid	W. J. Dunn, Covington, Tenn.	Covington,
246	1967	-----	Clover, white-dandelion	-----	None	Crystals	H. A. Schaeffer, Osseo, Wis.	Northern Trempealeau County,
247	1966	June 25	Clover, white-mixed clovers	MSC Apiary; primarily white clover, also hop, red, crimson clover	-----	Liquid	C. A. Wilson, State College, Miss.	N. E. prairie section,
248	1967	August	do	-----	-----	Beginning fine granulation	Tacoma Bros., Falmouth, Mich.	Missaukee County,

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color	Granulation	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezi-lose	Un-identified	pH	Free acid	Lac-tone	Total acid	Lac-tone/free acid	Ash	Nitro-gen	Dis-crease
617147			Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meg./kg	Meg./kg	Meg./kg		Percent	Percent	
230-----	6	4	17.8	13	36.96	31.26	1.77	7.18	1.39	-----	3.9	3.73	19.93	9.03	28.96	0.452	0.067	0.039	13.6
231-----	6	4	16.4	11	37.62	32.83	1.15	6.86	1.39	-----	3.8	3.67	20.87	12.1	38.98	.531	.067	.035	27.0
232-----	5	4	17.7	10	38.35	30.46	1.02	7.55	1.69	-----	2.6	3.96	16.46	6.57	22.05	.424	.062	.041	18.8
233-----	5	6	18.2	12	38.34	33.46	.96	5.28	.91	-----	2.8	3.86	29.20	12.30	41.50	.422	.137	.066	-----
234-----	4	0	21.0	3	38.11	28.13	.74	7.86	1.83	-----	3.4	3.62	31.35	13.37	44.72	.938	.040	-----	17.2
235-----	5	0	16.8	15	38.94	29.31	.86	9.20	1.62	-----	3.4	4.08	33.69	4.38	38.07	.853	.108	.031	12.3
236-----	4	4	18.4	13	38.48	32.10	.83	6.00	1.69	-----	2.5	3.90	22.52	6.97	29.49	.264	.036	.036	27.2
237-----	9	0	17.8	12	36.40	27.99	.85	8.73	2.72	-----	3.3	4.31	31.03	3.89	36.92	1.180	.348	.068	20.7
238-----	5	0	16.8	15	39.93	28.15	1.35	8.21	1.72	-----	3.8	3.90	16.46	3.27	19.73	1.199	.408	.043	10.6
Ave., 230-238.	5	2	17.9	12	38.19	30.41	1.06	7.43	1.65	-----	3.4	3.88	22.95	8.89	31.83	.377	.178	.047	24.0
239-----	4	5	17.8	12	38.39	31.58	1.11	6.73	1.33	0.18	2.9	3.75	15.74	5.10	20.84	.324	.028	-----	21.0
240-----	1	1	19.2	15	37.71	30.22	.83	7.68	1.63	-----	2.7	3.65	17.38	4.45	22.03	.553	.051	.036	-----
241-----	6	5	16.5	18	40.49	33.02	.90	6.60	.89	-----	1.6	3.82	35.55	15.01	50.57	.422	.199	.067	-----
Ave., 239-241.	4	4	17.8	15	38.86	31.61	.95	7.00	1.28	-----	2.4	3.73	22.96	8.19	31.15	.333	.091	.044	-----
Ave., 230-241.	5	3	17.9	12	38.36	30.71	1.03	7.32	1.56	-----	3.2	3.84	22.95	8.71	31.66	.366	.156	.046	-----
242-----	4	2	18.1	15	38.40	32.32	1.29	5.87	1.19	.71	2.1	3.70	22.53	9.68	32.21	.430	.077	.048	25.2
243-----	2	1	16.2	10	38.67	31.21	1.39	8.53	2.33	-----	1.7	3.77	12.23	5.32	17.56	.435	.020	.025	11.5
244-----	8	4	15.8	8	36.48	31.95	.90	6.46	1.10	-----	7.3	3.75	24.81	9.11	33.92	.367	.103	.018	24.0
245-----	6	1	18.7	7	38.19	31.84	2.32	5.04	1.33	.00	2.0	4.10	39.82	9.71	49.53	.244	.380	.036	-----
Ave., 244-245.	7	3	17.3	8	37.34	31.90	1.61	6.05	1.22	-----	4.7	3.89	32.32	9.41	41.73	.306	.242	.027	-----
246-----	1	3	19.6	17	37.55	30.56	.88	7.49	1.40	-----	2.5	3.80	17.90	4.33	22.24	.242	.068	.034	-----
247-----	8	1	18.8	13	37.10	30.86	1.04	7.38	1.29	-----	3.5	4.05	27.05	9.58	36.63	.333	.097	.052	20.7
248-----	3	4	17.3	6	36.97	32.93	.89	6.50	1.28	-----	4.1	3.80	17.13	3.99	23.11	.350	.065	.013	30.8
Ave., 247-248.	6	3	18.1	10	37.04	31.90	.97	6.94	1.29	-----	3.8	3.91	22.09	7.79	29.87	.352	.081	.033	25.7

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments 1	Producers' heating, °F.	Condition on receipt	Name and address of producer	Area produced
249.....	1957	May 10.....	Clover, white-spring blend.	Willow, Persian clover and blackberry.	None.....	Liquid.....	E. Oertel, Baton Rouge, La.....	E. Baton Rouge Parish.
250.....	1957	.....	Clover, white-sweet clover.	.....	.....	do.....	Wesley W. Stephens, West Branch, Mich.	Ogemaw County, Mich.
251.....	1956	Early August.....	Clover.....	Traces dandelion, locust, basswood, yetch, trefoil, alsike clover, alfalfa.	140° for 5 min.....	do.....	C. L. Farrar, Madison, Wis.....	Madison.
252.....	1956	September.....	Clover blend.....	.....	None.....	Granulated, still pourable.	Charles Mraz, Middlebury, Vt.....	Middlebury.
253.....	1956	.....	Clover.....	Stripped from Comb.	do.....	Partly granulated.	P. J. Hewitt, Jr., Litchfield, Conn.	Litchfield.
254.....	1956	Oct. 16.....	do.....	In comb.....	do.....	do.....	L. W. Sundberg, Richville, Minn.	Richville, Ottertail County.
255.....	1956	.....	do.....	A little alfalfa.	.....	do.....	E. M. Miller, Eastwood, Ky.....	Eastwood.
256.....	1956	.....	do.....	.....	.....	Liquid.....	Fisher Apiaries, Granville, Pa.	Granville.
257.....	1956	.....	do.....	.....	.....	do.....	Harold E. Swasey, Leicester, Mass.	Leicester.
258.....	1957	July 10.....	do.....	.....	None.....	do.....	Everett E. Fields, Bristol, R. I.	Bristol.
259.....	1957	.....	do.....	.....	.....	do.....	Robert Yenson, Homestead, Pa.	Wayne County.
260.....	1957	.....	do.....	.....	.....	do.....	Francis Morichka, Homestead, Pa.	Homestead.
261.....	1957	.....	do.....	.....	.....	do.....	do.....	Lake Ariel, Wayne County.
262.....	1957	.....	do.....	.....	.....	do.....	Jane Clarke, Center Hall, Pa.	Centre County.
263.....	1957	.....	do.....	.....	.....	do.....	do.....	Leont, Centre County.
264.....	1957	July 15.....	Clover.....	.....	None.....	do.....	Rudolph and Herb Studler, Glenville, Minn.	Glenville.
265.....	1957	.....	do.....	.....	.....	do.....	G. L. Hazeltine, Marion, Iowa.	Marion.
266.....	1957	.....	do.....	.....	None.....	do.....	Cecil W. Hoff, Eau Gallie, Fla.	Eau Gallie.
267.....	1957	Sept. 10.....	Clover blend.....	White and yellow sweet, alsike and white.	do.....	Partly granulated.	Gerald L. Hodson, Converse, Ind.	Miami County.
268.....	1957	.....	do.....	Alsike, white, ladino, sweet.	.....	Liquid.....	Earl R. Bronson, Salem, Ill.....	Salem.
269.....	1957	Aug. 20.....	Clover.....	.....	None.....	do.....	W. E. Lyman, Greenwich, N. Y.	St. Lawrence County.
270.....	1957	.....	do.....	.....	.....	do.....	Lloyd Stanley Gilbert, Iowa.	Fairbault, Blue Earth County.
271.....	1957	Aug. 15.....	do.....	Strained.....	100°.....	Solid granulation.....	Harry Stewart, Winnebago, Minn.	and Martin Counties.
272.....	1957	.....	Clover blend.....	.....	.....	Liquid.....	Earl Barham, Madison College, Tenn.	Davidson County.
273.....	1957	.....	do.....	Crimson, white, and sweet clover, yetch.	.....	do.....	Don Kloepfer, Grand Ledge, Mich.	Grand Ledge.
274.....	1957	Sept. 15.....	do.....	.....	140° for 25 min.....	do.....	J. E. Morgan, Van Wert, Ohio	Pleasant Township, Van Wert County.
275.....	1957	.....	Clover.....	.....	.....	Crystals.....	N. R. Chamberlin, Poplar, Wis.	Poplar.
276.....	1957	Aug. 15.....	do.....	.....	None.....	Solid granulation.....	Lee Reents, Lincoln, Nebr.....	Lincoln.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melzer-tose	Un-deter-mined	pH	Free acid	Lac-tone	Total acid	Lac-tone/free acid	Ash	Nitro-gen	Dia-stase
249.....	7	1	Percent 17.6	Month 6	Percent 37.55	Percent 28.31	Percent 0.39	Percent 8.15	Percent 1.04	Percent -----	Percent 7.0	4.29	Meg./kg 27.93	Meg./kg 5.49	Meg./kg 33.42	0.196	Percent 0.367	Percent 0.048	29.4
250.....	0	1	15.1	17	39.98	34.39	3.32	5.90	1.11	-----	.2	3.72	13.90	5.68	19.59	.409	.042	.035	20.0
251.....	4	5	16.7	11	38.14	34.81	2.18	5.52	1.04	-----	1.7	3.74	18.74	8.20	26.94	.437	.055	.036	15.2
252.....	4	6	15.6	10	38.32	33.29	1.06	7.45	2.37	-----	1.9	3.95	13.78	5.52	19.30	.402	.056	.028	13.5
253.....	9	1	17.4	9	38.71	30.20	1.02	8.23	2.24	-----	2.2	4.02	27.18	10.51	37.69	.386	.213	.023	13.3
254.....	5	4	18.0	12	37.80	32.55	.58	5.42	1.71	-----	2.9	3.70	28.24	11.89	40.13	.422	.125	.073	34.5
255.....	6	4	18.6	14	37.64	34.21	1.32	5.44	1.01	-----	1.8	3.62	25.91	11.41	37.32	.440	.048	.037	-----
256.....	4	4	17.9	14	37.65	31.81	1.83	6.05	1.56	-----	3.3	3.63	26.31	10.97	37.28	.415	.105	.044	14.4
257.....	5	4	15.7	14	37.25	31.56	3.67	7.61	1.83	-----	2.4	3.70	16.24	6.00	22.24	.369	.080	.037	3.1
Ave., 251-257.	5	4	17.3	12	37.83	32.63	1.67	6.53	1.68	-----	2.3	3.74	22.34	9.21	31.56	.410	.095	.040	15.7
258.....	4	1	19.3	22	34.48	28.34	.94	10.37	2.07	-----	4.5	4.10	24.06	7.73	31.80	.321	.411	.038	35.3
259.....	2	4	17.3	5	37.45	33.55	1.72	6.52	1.13	-----	2.3	3.80	15.90	6.81	22.71	.428	.035	.000	30.0
260.....	2	2	19.3	5	36.57	29.61	.56	6.49	1.20	-----	6.3	3.79	16.32	5.56	21.88	.340	.042	.007	21.4
261.....	5	2	19.0	5	36.62	32.48	.97	6.55	1.03	-----	3.4	3.61	21.25	6.58	27.83	.310	.074	.003	10.3
262.....	4	4	16.4	5	38.13	32.47	2.01	6.66	1.25	-----	3.1	3.87	17.53	7.35	24.88	.420	.053	.006	19.7
263.....	3	3	17.8	6	38.06	32.61	2.33	5.48	1.09	-----	2.3	3.80	18.42	8.47	26.89	.459	.034	.022	24.0
264.....	3	2	20.0	7	39.42	30.65	.50	5.43	.92	-----	3.1	3.70	18.62	5.10	23.69	.274	.047	.027	-----
266.....	5	0	18.4	9	38.79	30.69	.78	8.02	1.47	-----	2.8	4.30	12.24	6.55	19.79	.495	.192	.023	18.5
267.....	7	2	17.4	8	39.15	32.64	.94	5.44	.79	-----	2.2	3.61	32.63	6.55	45.05	.381	.096	.051	-----
268.....	2	2	17.8	8	37.89	32.91	1.75	5.40	1.53	-----	2.7	3.89	18.34	6.55	53.87	.405	.179	.054	26.7
269.....	2	2	16.2	8	39.29	32.28	.67	7.04	1.92	-----	1.6	3.71	15.15	3.75	18.90	.248	.042	.028	8.8
271.....	4	2	19.3	13	37.46	32.64	.86	5.72	1.00	-----	2.5	3.70	20.21	6.18	26.40	.306	.084	.040	10.5
272.....	4	0	19.2	15	36.10	31.47	1.11	7.24	1.32	-----	2.4	3.61	27.78	8.31	36.09	.299	.127	.051	10.5
274.....	2	2	17.2	15	38.89	33.47	1.39	6.46	1.08	-----	.9	3.68	23.21	10.25	34.46	.442	.079	.033	21.6
275.....	4	1	16.8	19	38.88	33.90	2.21	6.46	1.26	-----	2.7	3.92	17.40	7.30	24.70	.420	.068	.029	10.0
276.....	1	2	17.0	18	38.21	33.01	1.61	6.40	1.12	-----	2.7	3.92	13.21	8.51	21.73	.644	.041	.031	-----
Ave., 268-276.	4	2	18.0	11	37.81	32.05	1.33	6.63	1.26	-----	3.8	3.77	20.83	7.90	28.73	.387	.100	.030	19.7
Ave., 261-276.	4	3	17.8	11	37.84	32.22	1.44	6.60	1.39	-----	2.6	3.76	21.29	8.30	29.59	.394	.099	.033	18.4

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments 1	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
277.....	1956	September.....	Clover-alfalfa.....	U.M. Apiary; some basswood.....	100°.....	Beginning to granulate.....	M. H. Haydak, St. Paul, Minn.....	St. Paul.
278.....	1956	.....	do.....	Unstrained, same honey as 279.	155° for several hours.....	Liquid.....	E. H. Adey, Sutherland, Nebr.....	Sutherland.
279.....	1956	.....	do.....	Unstrained, heated in electronic oven.....	186° for 2½ min.....	do.....	do.....	Do.
280.....	1957	.....	do.....	.....	.....	Beginning to granulate.	James E. Bunch, Sunnyside, Wash.....	Sunnyside.
281.....	1957	Sept. 7.....	do.....	.....	.....	Crystals.....	George Biesterfeld, Little Chute, Wis.....	Outagamie County.
282.....	1957	July 20.....	do.....	Sweet and alsike clovers.	None.....	Granulated.....	John Speelman, Kalspell, Mont.....	Flathead Valley.
283.....	1957	.....	do.....	Alsike, white and sweet clover.	.....	do.....	Francis A. Schlitten, St. Paul, Minn.....	Washington County.
284.....	1957	.....	do.....	Alsike, white, yellow and white sweet clovers.	.....	Solid granulation.....	Lee Reents, Lincoln, Nebr.....	Lincoln.
285.....	1957	.....	Clover-asters.....	.....	.....	Granulated.....	Gale H. Patterson, Norwood, Colo.....	Norwood.
286.....	1957	Aug. 1.....	Clover-basswood.....	.....	.....	Partly granulated.	Ronald Wulf, Charles City, Iowa.....	Floyd County.
287.....	1957	.....	do.....	White sweet clovers from limestone hills.	None.....	Solid granulation.....	H. A. Schaefer, Osseo, Wis.....	Winona County, Minn.
288.....	1957	.....	Clover-basswood.....	White, and yellow sweet, white clovers from sand prairie.	None.....	Soft granulation.....	H. A. Schaefer, Osseo, Wis.....	Southern Trempealeau County.
289.....	1957	.....	do.....	Also fruit blossoms.	.....	Crystals.....	Burt L. Snyder, New Auburn, Wis.....	New Auburn.
290.....	1957	Late October.....	do.....	Also some alfalfa.	140°.....	Liquid.....	I. C. Andersen, Lake Benton, Minn.....	Lincoln County.
291.....	1956	August.....	Clover-blue thistle.....	.....	None.....	do.....	Harold L. Kelly, Silver Spring, Md.....	Washington County.
292.....	1957	.....	do.....	White and sweet clovers.	Yes.....	do.....	A. D. Hiett, Martinsburg, W. Va.....	Martinsburg.
293.....	1957	Aug. 1.....	Clover-cotton.....	.....	None.....	do.....	G. O. Stroope, Waxahachie, Texas.....	Ellis County.
294.....	1957	.....	Clover-fall blend.....	White, ladino clover; goldenrod, asters and fall flowers.	110°.....	Solid granulation.....	Nathan Paddock, Bruce, Wis.....	Bruce.
295.....	1957	Late.....	Clover-goldenrod.....	.....	.....	Liquid.....	Homer M. Dunn, Lisbon, N. Y.....	Lisbon.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melezitose	Undetermined	pH	Free acid	Lac-tone	Total acid	Lac-tone/free acid	Ash	Nitrogen	Dia-stase
277-----	4	4	Percent 18.5	Months 6	Percent 38.90	Percent 33.80	Percent 0.63	Percent 5.85	Percent 1.00	Percent -----	Percent 1.3	4.01	Meq./kg. 18.06	Meq./kg. 6.77	Meq./kg. 24.83	0.374	Percent 0.094	Percent 0.038	16.2
278-----	7	4	16.6	11	37.55	33.57	.44	6.39	.99	-----	4.5	3.82	16.13	8.18	24.31	.508	.067	.026	21.4
279-----	3	8	17.4	13	37.97	33.80	.84	5.87	.83	-----	3.3	3.82	15.08	7.46	22.54	.494	.104	.028	19.7
Ave., 277-279.	5	5	17.5	10	38.14	33.72	.64	6.04	.94	-----	3.0	3.87	16.42	7.47	23.89	.459	.088	.031	19.1
280-----	1	4	15.7	7	40.81	32.74	1.03	6.97	.95	-----	1.8	3.62	17.93	9.79	27.72	.546	.049	.020	-----
281-----	2	4	19.4	7	38.96	32.72	.59	5.61	.87	-----	1.8	3.80	17.22	6.83	24.04	.397	.052	.030	-----
282-----	1	6	16.2	10	39.94	33.01	1.03	6.80	1.18	0.00	1.8	3.68	15.71	4.50	20.20	.286	.069	.033	-----
283-----	3	2	18.4	17	37.94	31.35	1.04	6.52	1.28	-----	3.5	3.72	17.22	6.45	23.67	.375	.050	.039	-----
284-----	4	1	16.9	20	39.16	33.14	1.72	5.86	1.06	-----	2.2	3.81	19.27	7.33	26.60	.380	.070	.049	-----
Ave., 280-284.	2	3	17.3	12	39.36	32.59	1.08	6.35	1.07	-----	2.2	3.72	17.47	6.98	24.45	.397	.058	.034	-----
Ave., 277-284.	3	4	17.4	11	38.90	33.02	.92	6.23	1.02	-----	2.5	3.77	17.08	7.16	24.24	.420	.069	.033	-----
285-----	8	0	16.4	7	37.18	28.80	.70	10.16	2.44	-----	4.3	4.72	32.70	2.67	35.36	.082	.562	.078	-----
286-----	1	1	17.9	7	39.15	31.61	.67	6.98	1.03	-----	2.7	3.91	14.28	4.13	18.41	.289	.073	.022	-----
287-----	2	1	19.0	14	38.13	30.27	1.13	6.91	1.39	-----	2.3	3.73	17.39	5.71	23.10	.328	.074	.033	-----
288-----	1	4	18.9	13	37.60	30.01	.93	7.23	1.36	-----	4.0	3.90	14.92	4.15	19.07	.278	.084	.027	-----
289-----	4	4	17.7	17	37.23	31.01	.88	7.56	1.83	-----	3.8	4.05	15.81	5.13	20.94	.325	.124	.031	-----
290-----	2	3	18.0	16	38.72	32.71	1.55	6.71	1.09	.00	1.2	3.82	13.81	2.99	16.80	.217	.074	.026	-----
Ave., 286-290.	2	2	18.3	13	38.17	31.12	1.03	7.08	1.34	-----	2.8	3.87	15.24	4.42	19.66	.257	.086	.028	-----
291-----	6	0	17.0	15	38.14	30.15	.80	8.84	1.48	-----	3.6	3.78	27.36	8.80	36.16	.322	.141	.040	-----
292-----	7	0	18.4	21	37.92	31.02	.97	6.63	2.03	.61	2.4	3.79	29.22	10.53	39.75	.360	.156	.070	-----
Ave., 291-292.	7	0	17.7	18	38.03	30.59	.89	7.74	1.76	-----	3.0	3.79	28.29	9.67	37.96	.341	.149	.055	-----
293-----	4	7	17.8	5	37.93	35.10	.71	5.41	.44	-----	3.3	4.08	27.18	6.45	33.63	.247	.185	.014	29.3
294-----	4	2	17.9	14	37.73	29.86	1.17	8.06	1.31	-----	4.0	4.13	18.18	5.68	23.86	.312	.136	.044	-----
295-----	4	1	17.1	7	39.23	32.94	1.22	6.24	1.43	-----	1.9	3.75	17.55	5.08	22.63	.290	.075	.036	20.4

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, °F.	Condition on receipt	Name and address of producer	Area produced
296	1937	Aug. 30.	Clover-heartsease			Beginning to granulate.	Ronald Wulff, Charles City, Iowa.	Floyd County.
297	1937	July 1.	Clover-margold		None.	Liquid.	G. O. Strope, Waxahachie, Texas.	Ellis County.
298	1937	Sept. 2.	Clover-purvel.		do.	do.	F. R. Buchanan, Whitemarsh, Pa.	Cape May, N. J.
299	1937	Sept. 2.	Clover-sourwood.	White sweet and white clovers.	do.	do.	John Amos, Cambria, Va.	Montgomery County.
300	1936	July 7.	Clover-natural		140°	Beginning to granulate.	James Youngblood, Ennis, Texas	Ennis.
301	1937	July	Clover-natural summer blend.	Strained		Liquid.	Charles G. Bennett, Muscatine, Iowa.	Muscatine.
302	1937	July	do.	Wild mustard, fruit blossoms, locust and berries.		do.	Leonard E. Good, Spinnertown, Pa.	Bucks County.
303	1937		do.	White, alsike clover, raspberry and bass-wood.	110°	Solid granulation.	Nathan Paddock, Bruce, Wis.	Bruce.
304	1937	July 25.	Clover-birdsfoot		None.	Crystals	W. E. Lyman, Greenwich, N. Y.	Washington County.
305	1937	Oct. 15.	Clover-vetch		130-140°	Liquid.	W. E. Drane, Forest, La.	Tensas Parish.
306	1936	Oct. 12.	Coralvine			do.	W. Wortham Maxwell, San Antonio, Texas.	San Antonio.
307	1937	Oct. 20.	Coralvine	Pure	None.	do.	C. L. Benson, Phoenix, Ariz.	Do.
308	1936	Oct. 12.	Cotton	Short staple cotton (Upland).		Solid granulation.	James Youngblood, Ennis, Texas	Northern Phil Country.
309	1936	Nov. 7.	do.		do.	Soft granulation.	C. M. Bledsoe, Phoenix, Ariz.	Ennis.
310	1937		do.			do.	James Youngblood, Ennis, Texas	Maricopa County.
311	1937	Sept. 20.	do.			Crystals	Charles Frederick Shandon, Calif.	Kings County.
312	1936	October	Cotton	Strained	Yes, to melt.	Liquid.	E. S. Boswell, Chowchilla, Calif.	Fresno County.
313	1937	Sept. 5.	do.	Pure		Solid granulation.	Robert Reed, Safford, Ariz.	Safford.
314	1937	September	do.	Unstrained	None.	do.	Glenn H. Benson, Phoenix, Ariz.	Final County.
315	1937		do.		do.	do.	Glenn Gibson, Mineo, Okla.	Final County.
316	1937		do.	Fermented		do.	Koy Stanley, Terra Bella, Calif.	Tulare County.
317	1937	September	do.		None.	do.	O. L. Tolman, Cotulla, Texas.	Hale County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Mol- turity	Age	Levu- lose	Dex- trose	Sucrose	Malt- tose	Higher sugars	Malezi- tose	Unde- ter- mined	pH	Free acid	Lac- tone	Total acid	Lac- tone/ free acid	Ash	Nitro- gen	Dia- stase
206-----	4	1	Percent 17.4	Months 7	Percent 41.49	Percent 31.21	Percent 0.88	Percent 6.11	Percent 1.06	Percent -----	Percent 1.8	3.92	Mg./kg. 17.36	Mg./kg. 3.57	Mg./kg. 20.92	0.206	Percent 0.049	Percent 0.054	36.6
207-----	4	5	18.0	6	37.80	34.18	.87	5.74	.54	-----	2.9	3.65	26.40	11.28	37.68	.427	.085	.080	25.6
208-----	2	2	17.0	10	39.03	30.46	1.00	7.40	3.40	-----	1.7	3.83	15.58	6.36	21.94	.408	.090	.086	20.7
209-----	5	1	18.3	7	40.22	28.97	.62	6.99	1.40	-----	3.4	3.83	25.38	10.38	35.76	.409	.132	.052	34.1
300-----	6	7	15.6	12	39.34	34.97	1.00	6.15	.87	-----	1.5	3.98	24.22	10.50	34.72	.433	.089	.040	10.4
301-----	4	4	19.8	5	38.16	31.96	.49	5.66	1.19	-----	2.7	4.12	17.23	4.50	21.73	.261	.171	.020	13.0
302-----	7	1	17.0	8	38.37	31.76	.60	7.06	1.05	-----	2.2	4.12	23.73	7.23	30.96	.305	.184	.043	26.7
303-----	3	1	17.3	17	37.70	30.99	.96	8.00	1.47	-----	2.6	4.02	17.06	7.01	24.07	.411	.115	.034	-----
Ave., 301-303.	5	2	18.0	10	38.08	31.57	.68	6.91	1.24	-----	3.2	4.08	19.34	6.25	25.59	.326	.157	.032	19.8
304-----	5	3	17.5	10	38.99	33.18	1.10	5.89	1.34	0.00	2.0	3.52	31.52	12.03	43.55	.382	.102	.074	-----
305-----	5	4	16.7	21	38.89	30.61	.76	8.41	1.56	.72	2.4	3.90	16.98	5.54	22.52	.326	.076	.042	-----
306-----	11	-----	16.3	14	34.87	28.68	.60	6.16	3.05	3.15	7.2	4.35	46.51	9.30	54.81	.204	.616	.039	-----
307-----	11	0	17.2	2	34.84	28.24	.62	6.05	3.01	3.05	8.5	4.30	46.91	8.50	55.41	.181	.567	.074	-----
Ave., 306-307.	11	0	16.8	8	34.86	28.46	.61	6.11	3.03	-----	7.9	4.32	46.21	8.90	55.11	.168	.592	.057	-----
308-----	7	8	15.7	5	39.36	36.89	1.11	5.11	.64	-----	1.2	4.53	20.41	2.68	23.09	.132	.321	.021	12.2
309-----	4	3	15.4	3	40.14	36.66	.66	4.97	.53	-----	1.6	4.30	27.61	8.48	36.09	.207	.292	.054	21.8
310-----	6	9	16.2	5	39.91	38.93	2.32	4.59	.29	.00	1.0	4.20	28.60	6.48	35.08	.251	.402	.018	-----
311-----	7	6	16.0	7	40.32	37.07	.74	4.70	.36	-----	.8	4.14	25.07	9.78	34.85	.300	.304	.044	28.6
312-----	4	9	15.6	4	39.67	33.99	3.02	5.56	.68	.68	1.3	4.19	16.50	3.78	20.37	.228	.146	.030	-----
313-----	4	7	17.8	24	39.19	38.34	.55	7.74	1.00	-----	1.9	4.35	19.47	3.78	23.25	.208	.428	.026	-----
314-----	5	8	15.7	13	37.85	37.25	.70	5.74	.37	-----	3.4	4.61	22.70	2.19	24.89	.208	.472	.031	-----
315-----	5	9	16.4	13	38.81	35.04	.60	5.86	.45	-----	3.3	4.45	25.49	8.27	33.76	.207	.321	.036	-----
316-----	5	9	16.6	14	39.31	37.50	.81	5.86	.35	-----	1.1	4.40	24.80	8.41	33.21	.208	.325	.036	-----
317-----	4	7	15.8	16	38.71	37.77	.94	5.08	.32	-----	1.4	4.00	24.80	1.08	26.88	.008	.386	.041	-----
Ave., 308-317.	5	8	16.1	10	39.28	36.74	1.14	4.87	.50	-----	2.3	4.29	24.61	5.21	29.82	.207	.339	.037	-----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
318	1957	-----	Cotton-alfalfa	-----	-----	Solid granulation	H. I. Weathers, Kernan, Calif.	Fresno County.
319	1957	-----	do	-----	-----	do	R. H. Lane, Porterville, Calif.	Tulare County.
320	1956	-----	Cranberry	-----	-----	Few crystals	Justin Caswell, Middleboro, Mass.	Middleboro.
321	1956	October	do	-----	None	Liquid	Karl W. P. Reece, Whitman, Mass.	Whitman.
322	1957	October	Crotalaria	-----	-----	Few crystals	M. V. Coggeshall, Minneola, Fla.	Lake County.
323	1957	-----	Chunimber	-----	-----	Liquid	Ralph Wilson, Belmont, Iowa	Belmont.
324	1956	April	Eucalyptus	-----	-----	Granulated	Loren Vernon, Sonoma, Calif.	Sonoma County.
325	1957	April 15	do	-----	-----	Liquid	M. E. Thacker, Santa Ana, Calif.	Irvine, Orange County.
326	1956	-----	Fireweed	-----	None	do	G. V. Palmrose, Beaverton, Oregon	Tillamook burn area.
327	1956	-----	do	-----	None	Granulated	H. J. Moulton, Portland, Oreg.	Coast mountains, Oregon.
328	1957	Sept. 1	do	-----	Mild	-----	Oliver Petty, Albany, Oreg.	Sweet Home, Linn County.
329	1956	June	-----	-----	-----	-----	-----	-----
330	1957	April 26	Gallberry	-----	None	Liquid	J. H. Ghardeau, Jr., Tifton, Ga.	Alapaha, Glades County, Florida.
331	1957	June	do	-----	120°	do	H. M. Myers, Ransomville, N. Y.	Tift County.
332	1957	June	do	-----	-----	do	J. H. Ghardeau, Jr., Tifton, Ga.	Alapaha, Bertien County.
333	1957	-----	do	-----	None	do	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
334	1957	June 20	do	-----	Flush to 130°	do	Adolphus Jones, Bay Minette, Ala.	Baldwin County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups—Continued*

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melittose	Undetermined	pH	Free acid	Lactic tone	Total acid	Lactic tone/ free acid	Ash	Nitrogen	Dia-stase
318-----	4	5	Percent 15.9	Months 16	Percent 34.84	Percent 34.84	Percent 1.20	Percent 5.96	Percent .62	Percent -----	Percent 2.1		Meq./kg. 26.98	Meq./kg. 8.13	Meq./kg. 35.11	0.271	Percent 0.226	Percent 0.049	-----
319-----	7	9	16.1	14	39.11	36.00	1.46	5.25	.65	-----	1.4	3.91	34.87	11.35	46.22	.356	.229	.058	-----
Ave., 318-319.	5	7	16.0	15	39.27	35.42	1.33	5.60	.63	-----	1.8	3.86	30.92	9.74	40.67	.298	.227	.053	-----
320-----	8	1	17.4	16	36.29	29.42	.87	7.36	2.48	-----	6.2	4.38	18.89	6.04	24.93	.320	.296	.039	-----
321-----	9	0	17.0	15	34.89	26.84	1.17	8.69	3.41	0.44	8.0	4.36	28.75	6.59	35.34	.228	.364	.043	26.7
Ave., 320-321.	9	1	17.2	16	35.59	28.13	1.02	8.03	2.95	-----	7.1	4.37	23.52	6.32	30.14	.274	.330	.041	-----
322-----	9	0	18.4	14	37.34	31.41	1.17	7.17	1.21	.62	2.7	3.78	31.23	12.70	43.93	.407	.167	.056	13.2
323-----	4	1	18.7	11	38.20	32.59	1.45	5.66	.96	-----	2.4	3.82	21.12	9.41	30.52	.444	.094	.045	15.8
324-----	6	3	17.3	18	39.28	32.93	.65	5.93	.69	-----	3.2	4.10	22.06	10.24	32.30	.464	.226	.056	31.6
325-----	6	2	16.6	18	39.41	31.60	2.20	7.74	.91	-----	1.5	4.18	15.85	4.77	20.62	.301	.182	.043	12.2
Ave., 324-325.	6	3	17.0	18	39.35	32.27	1.43	6.84	.80	-----	2.4	4.14	18.96	7.51	26.46	.383	.204	.050	21.9
326-----	5	1	16.6	12	40.00	28.82	.82	8.54	2.62	-----	2.6	4.10	16.28	3.40	19.68	.209	.110	.027	17.6
327-----	6	9	15.7	8	40.29	32.61	1.00	6.49	1.76	-----	2.2	3.80	22.01	10.28	32.29	.467	.151	.034	-----
328-----	1	2	15.8	17	39.13	30.74	2.01	6.34	1.80	2.87	1.3	3.68	19.61	8.74	28.35	.446	.094	.036	-----
Ave., 326-328.	4	4	16.0	20	39.81	30.72	1.28	7.12	2.06	-----	2.0	3.83	19.30	7.47	26.77	.374	.108	.032	-----
329-----	4	0	15.4	12	40.89	27.45	.92	10.44	1.66	-----	3.2	4.75	8.89	1.24	10.13	.140	.072	.024	12.5
330-----	4	7	17.4	8	39.26	31.43	.52	6.18	1.05	.00	4.2	4.21	14.79	7.18	21.97	.485	.265	.014	23.5
331-----	6	0	15.7	9	40.43	30.24	.35	6.87	1.15	-----	5.3	4.38	23.66	6.17	29.83	.261	.247	.025	21.4
332-----	5	0	18.6	8	39.73	28.48	.62	7.86	.89	.43	1.8	4.30	15.72	3.30	19.02	.210	.099	.018	18.0
333-----	4	2	18.4	20	39.63	32.24	1.20	6.42	1.39	-----	.3	3.81	17.77	5.71	23.48	.321	.101	.043	15.2
334-----	6	0	16.0	21	39.14	30.06	.70	8.49	1.19	-----	4.4	4.30	16.29	3.17	19.46	.185	.196	.044	-----
Ave., 329-334.	5	2	17.1	13	39.85	30.15	.72	7.71	1.22	-----	3.2	4.20	16.19	4.46	20.65	.269	.163	.028	18.1

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
335.	1957	May	Gallberry-holly			Semigranulated.	T. B. Brewer, Lake View, S. C.	Lake View.
336.	1957	Oct. 1	Goldenrod	In comb.	None	Liquid	Arthur T. Barker, Thrusville, Pa.	Thrusville.
337.	1957	Sept. 28	Goldenrod		None	Solid granulation.	Andrew Meshaw, Transfer, Pa.	Crawford County.
338.	1957		do.			Liquid	Ansel B. Moshier, Warner, N. H.	Sutton, Merrimack County.
339.	1956	Oct. 15.	Goldenrod-aster	Sample scraped directly from honeycomb.	do.	Partly granulated.	P. J. Hewitt, Jr., Litchfield, Conn.	Litchfield.
340.	1956	do.	do.	C. U. Apiary.	do.	Liquid	Norman E. Garry, Ithaca, N. Y.	Tompkins County.
342.	1957	Oct. 13.	Goldenrod-buck-wheat.	C. U. Apiary; unstrained.	do.	Crystals.	do.	Ithaca.
343.	1957	Sept. 10	Goldenrod-rasp-berry.	10% raspberry.	do.	Partly granulated.	W. E. Lyman, Greenwich, N. Y.	Franklin County.
344.	1957		Grape, scupper-horn.			do.	Michael McLaurnin, Fayetteville, N. C.	Fayetteville.
345.	1956	July	Gum, black-tupelo.	Unstrained (in comb).	None	Liquid	John Wood, Plymouth, N. C.	Plymouth, Washington County.
346.	1956		Heartsease	Smartweed.		Partly granulated.	Walter Witherell, Westhampton, Mass.	Westhampton.
347.	1957	Oct. 15.	do.	Produced 8/20-9/10 strained.	100°	Crystals.	Harry Stewart, Winnebago, Minn.	Fairbault, Blue Earth and Martin Counties.
348.	1957	October	Heartsease-clover	Also some aster		Soft granulation.	Lloyd A. Lindemulser, Tremont, Ill.	Tremont.
349.	1957	Sept. 1.	Heartsease-fall black.		None	Liquid	Rudolph and Herb Studer, Glen-ville, Minn.	Glenville.
350.	1957	Oct. 10.	do.	Catnip and white aster.	10 min.	do.	Ray Silver, Logansport, Ind.	Clay Township, Cass County.
351.	1956		Holly			do.	A. Strang, Lundy, Md.	Lundy.
352.	1956		do.		None	do.	R. R. Boyer, Hollywood, Md.	St. Marys County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color	Granulation	Moisture	Age	Lavulose	Dextrose	Sucrose	Maltose	Higher sugars	Melastose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
335-----	7	1	Percent 17.4	Months 20	Percent 39.67	Percent 28.39	Percent 0.97	Percent 9.52	Percent 1.21	Percent -----	Percent 2.8	4.01	Meg./kg. 27.44	Meg./kg. 8.14	Meg./kg. 35.58	0.297 0.159	Percent 0.159	Percent 0.057	-----
336-----	5	2	16.4	7	40.61	33.75	.52	6.74	.41	-----	1.6	5.01	14.11	.00	14.11	.000	.294	.027	24.0
337-----	7	4	17.8	9	38.42	32.52	.44	6.92	.37	-----	3.8	4.50	26.45	3.40	30.35	.147	.360	.064	-----
338-----	5	5	16.7	9	39.68	33.19	.57	6.36	.98	-----	2.5	4.18	19.24	2.43	21.68	.126	.224	.044	30.8
Ave., 336-338.-	6	4	17.0	8	39.57	33.15	.51	6.57	.59	-----	2.6	4.45	19.93	2.11	22.05	.091	.263	.045	37.4
339-----	8	0	17.0	9	35.65	29.00	.42	7.04	4.97	-----	5.9	4.14	33.96	8.67	42.63	.254	.297	.055	-----
340-----	9	0	21.4	10	36.08	31.45	.64	5.87	.89	-----	3.7	4.02	35.15	8.51	43.96	.251	.221	.068	46.2
Ave., 339-340.-	9	0	19.2	10	35.87	30.23	.53	6.46	2.93	-----	4.8	4.08	34.56	8.74	43.30	.253	.259	.077	-----
342-----	8	4	17.4	11	37.47	31.91	.69	7.96	1.01	-----	3.6	4.10	29.18	5.83	35.02	.200	.177	.078	-----
343-----	4	1	18.9	8	40.60	31.96	.70	5.96	.63	-----	1.2	3.97	20.31	2.85	23.16	.140	.166	.039	-----
344-----	12	0	21.2	18	34.40	25.42	1.12	11.47	1.55	-----	4.8	4.03	35.83	8.64	44.47	.241	.239	.082	-----
345-----	7	1	17.6	15	41.49	31.64	.82	5.73	.79	-----	2.0	3.93	22.56	9.34	31.90	.414	.137	.033	17.6
346-----	6	8	18.6	13	36.70	36.46	3.21	4.19	.42	-----	.4	4.38	19.59	1.43	21.02	.073	.228	.042	-----
347-----	5	1	20.6	11	37.76	29.49	.68	7.23	.83	-----	3.4	3.88	21.80	3.77	25.57	.173	.094	.075	-----
Ave., 346-347.-	6	4	19.6	12	37.28	32.98	1.95	5.71	.63	-----	1.9	4.06	20.70	2.60	23.30	.123	.161	.060	-----
348-----	5	0	19.5	14	36.62	29.97	2.27	6.49	1.76	0.34	3.1	3.60	23.34	6.33	29.67	.271	.154	.057	-----
349-----	5	0	19.0	5	40.52	29.87	.69	6.70	.74	-----	2.5	3.95	20.11	4.63	24.74	.230	.078	.048	35.3
350-----	6	1	17.3	12	37.64	31.82	1.71	5.91	.93	.00	4.7	3.60	29.95	11.16	41.12	.373	.110	.068	23.6
Ave., 349-350.-	6	1	18.2	9	39.08	30.85	1.20	6.31	.84	-----	3.6	3.74	25.04	7.90	32.93	.302	.094	.058	29.4
351-----	8	0	17.4	16	38.46	25.99	.90	11.07	2.10	-----	4.1	4.42	21.73	5.07	26.80	.293	.246	.024	-----
352-----	8	0	18.7	16	39.50	25.30	1.09	9.06	2.21	-----	4.1	4.31	19.45	3.51	23.26	.196	.158	.033	-----
Ave., 351-352.-	8	0	18.1	16	38.98	25.65	1.00	10.07	2.16	-----	4.1	4.36	20.59	4.44	25.03	.215	.202	.029	-----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
353.....	1957	-----	Holly-vetch.....	-----	140° for 30 min.	Liquid.....	H. J. Moulton, Portland, Ore.....	Portland.
354.....	1957	July 12.....	Horsemint.....	Dry-poor yield unstrained.	None.....	do.....	Roy S. Weaver, Jr., Navasota, Texas.	Navasota, Grimes County.
355.....	1957	July 29.....	do.....	-----	do.....	Some crystals.....	Joseph Coufal, Fayetteville, Texas.	Fayetteville.
356.....	1956	-----	Knapweed, brown.	A star thistle	-----	Granulated.....	Warren A. Malick & Son, Pottsville, Pa.	Pottsville.
357.....	1957	Aug. 15.....	Knapweed, Russian.	-----	-----	Liquid.....	W. R. Hettrick, Hamilton, Mont.	Ravalli County.
358.....	1957	Sept. 14.....	Knapweed, Russian-white sweet clover.	Unstrained	None.....	Partly granulated.....	J. F. Meade, Pablo, Mont.....	Front Creek, Sanders County.
359.....	1957	-----	Lespedeza.....	In comb.	do.....	Liquid.....	G. E. Curtis, Graham, N. C.....	Aberdeen.
360.....	1956	-----	Locust, black	Nearly pure.	110°.....	do.....	Claude Rose, Madison, Ind.....	Jefferson County.
361.....	1956	May 30.....	do.....	Strained.	-----	do.....	Arthur G. Strang, Silver Spring, Md.	Lusky, Calvert County.
362.....	1956	June.....	do.....	Also white clover (fermented).	135°.....	do.....	H. R. Swisher, Springfield, Ohio.	Clarke County.
363.....	1957	-----	Locust, black-tulip tree.	-----	None.....	do.....	Bruce Anderson, Chatham, Va.....	Chatham.
364.....	1957	-----	Mallow weed.....	-----	Slightly.....	Beginning to granulate.	C. M. Bledsoe, Phoenix, Ariz.....	Maricopa County.
365.....	1956	May.....	Manzanita.....	-----	-----	Granulated.....	Charles Arnold, Washoe City, Nevada.	Washoe City.
366.....	1957	June 1.....	do.....	Unstrained	None.....	Crystals.....	Hammond & Gentry, Oakdale, Calif.	Mariposa County.
367.....	1957	do.....	Marigold.....	-----	do.....	Liquid.....	G. O. Stroope, Waxahachie, Texas.	Ellis County.
368.....	1956	May 1.....	Mesquite.....	-----	do.....	Granulated.....	Mevin Beatty, Westmorland, Calif.	16 miles west of Westmorland.
369.....	1957	May 3.....	do.....	Almost pure.	do.....	Soft granulation.....	Carl Powers, Parker, Ariz.....	Colorado River Indian Reservation.
370.....	1956	-----	do.....	-----	Some.....	Slight granulation.....	C. M. Bledsoe, Phoenix, Ariz.....	Pinal County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups—Continued*

Sample No.	Color ¹	Granulation ¹	Mol- ture	Age	Levu- lose	Dex- trose	Sucrose	Malt- ose	Higher sugars	Melazi- tose	Under- fer- mented	pH	Free acid	Lac- tone	Total acid	Lac- tone/ free acid	Ash	Nitro- gen	Dia- stase
353-----	6	0	Percent 16.5	Months 21	Percent 37.93	Percent 31.05	Percent 0.82	Percent 8.30	Percent 2.13	Percent 0.69	Percent 2.4	3.89	Meg./kg. 22.42	Meg./kg. 10.38	Meg./kg. 32.80	0.463	Percent 0.131	Percent 0.051	-----
354-----	3	1	18.9	5	37.36	34.25	1.01	5.05	.82	-----	2.6	3.75	28.86	14.71	43.57	.511	.252	.039	-----
355-----	5	1	18.6	11	37.38	33.00	1.01	6.00	.64	-----	3.4	3.70	28.15	12.77	40.91	.454	.189	.050	21.7
Ave., 354-355.	4	1	18.8	8	37.37	33.63	1.01	5.53	.73	-----	3.0	3.72	28.51	13.74	42.24	.483	.221	.045	-----
356-----	9	0	18.8	13	36.69	28.62	.60	7.57	3.09	-----	4.6	4.17	34.36	7.47	41.83	.217	.345	.062	22.6
357-----	4	1	15.0	9	39.33	31.59	1.65	7.39	2.25	.00	2.8	3.62	17.72	5.83	23.56	.329	.071	.041	33.3
358-----	2	1	15.8	6	38.11	29.76	1.04	8.21	3.22	.00	2.9	4.09	14.76	7.51	22.27	.509	.109	.032	-----
359-----	4	1	16.5	21	37.22	30.37	.84	8.84	1.38	.62	4.2	3.61	24.24	11.95	36.19	.493	.110	.063	43.5
360-----	1	0	15.8	13	43.29	24.34	.63	10.14	2.87	-----	2.9	4.30	7.64	2.15	9.88	.281	.043	.019	7.5
361-----	5	0	17.8	16	40.67	27.14	1.00	9.21	1.89	-----	2.3	4.10	13.47	3.97	17.44	.294	.069	.019	14.6
362-----	4	4	18.2	17	38.02	32.51	1.39	5.91	.94	-----	3.0	3.82	14.53	5.96	20.49	.410	.044	.017	-----
Ave., 360-362.	3	1	17.3	15	40.66	28.00	1.01	8.42	1.90	-----	2.7	4.03	11.88	4.03	15.94	.328	.052	.018	11.0
363-----	8	0	16.2	7	37.88	24.60	.67	11.77	3.38	-----	5.5	4.99	34.03	2.00	36.03	.059	.595	.063	25.4
364-----	8	4	16.0	7	40.79	34.40	1.27	5.99	.43	-----	1.1	3.82	29.72	16.68	46.39	.561	.247	.027	-----
365-----	5	9	17.0	10	34.68	40.72	.37	5.35	.77	-----	1.2	4.42	12.89	4.10	16.99	.318	.214	.038	7.8
366-----	4	5	18.7	16	35.07	33.48	1.23	7.16	2.02	.00	2.3	4.20	14.82	4.41	19.24	.298	.202	.019	-----
Ave., 365-366.	5	7	17.9	13	34.88	37.10	.80	6.26	1.40	-----	1.8	4.30	13.86	4.26	18.12	.308	.208	.029	-----
367-----	4	4	19.3	7	37.08	34.22	.93	5.30	.44	-----	2.7	3.60	23.42	12.26	35.68	.524	.076	.034	27.3
368-----	5	8	16.2	15	38.70	36.93	.64	5.66	.47	-----	1.5	4.19	12.56	3.18	15.74	.254	.104	.017	-----
369-----	5	5	15.4	6	41.39	37.89	1.00	5.99	.26	.00	1.1	4.20	12.50	2.28	14.78	.182	.124	.005	8.3
370-----	8	9	14.8	21	41.14	35.87	1.21	6.71	.32	-----	0	4.22	16.16	2.32	18.48	.144	.158	.013	-----
Ave., 368-370.	5	7	15.5	14	40.41	36.90	.95	5.42	.35	-----	3.8	4.20	13.74	2.59	16.33	.183	.129	.012	-----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
371-----	1957	September	Mexican clover			Liquid	J. H. Girardeau, Jr., Tifton, Ga.	Tifton, Tift County.
372-----	1957		Mini.			do.	G. L. Hazeltine, Marion, Iowa	Marion.
373-----	1957	July	Mountain laurel	Toxic, produced above 2,600 ft.		do.	Roy D. Brown, Del Rio, Tenn.	Cocke County.
374-----	1957	May 6.	Mustard		None	do.	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
375-----	1957		Oak poison			do.	Xavier Widmer, Medford, Oreg.	Medford.
376-----	1956		do.			Granulated	William M. Perry, McMinnville, Oreg.	McMinnville.
377-----	1956	June 1	Orange		110°	do.	William Ross, Valermo, Calif.	Los Angeles County.
378-----	1956		do.		None	Partly granulated.	R. W. Taylor, Alhambra, Calif.	San Dimas.
379-----	1957		do.			Crystals	L. B. Crawford, Santa Ana, Calif.	Orange County.
380-----	1957		Orange-grapefruit.		None	Liquid	A. S. Howard, Lake Placid, Fla.	Lake Placid.
381-----	1957		do.		do.	Beginning to granulate.	R. N. Neeley, Orlando, Fla.	Orlando.
382-----	1957		do.		do.	Liquid	Henry Brown, Kissimmee, Fla.	Kissimmee.
383-----	1957		do.		do.	do.	Keith Oederirk, Haines City, Fla.	Haines City.
384-----	1957		do.		do.	do.	L. T. Dyer, Lake Butler, Fla.	Lake Butler.
385-----	1957		do.		do.	do.	J. D. Haynie, Gainesville, Fla.	Seville.
386-----	1957	Mar. 12	do.		do.	do.	Conrad Kramer, Sharpes, Fla.	Minneola.
387-----	1957		do.		do.	do.	Raymond Bailey, Sharpes, Fla.	Tavares.
388-----	1957		do.		do.	do.	Millard Cogeshall, Minneola, Fla.	Minneola.
389-----	1957		do.		do.	do.	Arthur Brew, Umatilla, Fla.	Umatilla.
390-----	1957		do.		do.	do.	Frank Robinson, Gainesville, Fla.	Tavares.
391-----	1957		do.		do.	do.	do.	Clermont.
392-----	1957		Orange-grapefruit.				A. T. Uzzell, Moore Haven, Fla.	Moore Haven.
393-----	1957		do.		To strain.	Crystals	E. S. Bostwick, Chowchilla, Calif.	Tulare County.

See footnote at end of table.

TABLE 27.—*Composition of honey samples and averages of selected groups—Continued*

Sample No.	Color ¹	Granulation ¹	Molts-ture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Melittose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Diastase
371-----	9	0	Percent 18.2 Months 6	Percent 38.28 38.28	Percent 29.42 29.42	Percent 0.75 0.75	Percent 7.94 7.94	Percent 1.38 1.38	Percent 0.00 0.00	Percent 4.0 4.0	3.90	Mag./kg. 42.23 42.23	Mag./kg. 13.56 13.56	Mag./kg. 55.79 55.79	0.321 0.321	Percent 0.268 0.268	Percent 0.067 0.067	27.8	
372-----	1	2	18.8	38.84	33.33	2.10	4.93	.96	0.00	1.0	4.01	15.90	7.85	23.75	.494	.123	.019	15.0	
373-----	1	1	15.6	35.30	24.21	.52	17.64	2.48	.00	4.3	4.49	11.36	1.22	12.58	.107	.219	.029	33.0	
374-----	9	0	18.1	37.26	26.43	.45	11.11	1.68	-----	5.0	4.38	30.00	4.55	34.55	.152	.324	.070	18.8	
375-----	4	1	15.6	37.74	28.90	.76	9.83	2.34	.00	4.8	4.41	15.88	5.16	20.74	.331	.180	.046	28.6	
376-----	6	1	16.4	36.41	27.42	.55	10.49	3.24	-----	5.5	4.70	20.09	5.80	25.89	.289	.387	.056	-----	
Ave., 375-376.	5	1	16.0	37.08	28.16	.66	10.16	2.79	-----	5.2	4.53	17.84	5.48	23.32	.310	.284	.051	-----	
377-----	5	5	17.8	38.65	33.52	1.35	5.64	1.02	-----	2.1	3.68	27.12	14.84	41.96	.548	.074	.029	-----	
378-----	2	4	15.3	40.90	30.48	1.58	6.46	1.50	-----	3.8	3.73	22.80	11.39	34.19	.497	.083	.033	15.8	
379-----	4	2	17.1	38.23	31.49	2.68	7.41	1.47	-----	1.6	3.60	22.77	13.12	35.89	.576	.084	.029	-----	
Ave., 377-379.	4	4	16.7	39.26	31.83	1.87	6.50	1.33	-----	2.5	3.67	24.23	13.12	37.35	.540	.082	.030	-----	
380-----	8	0	-----	-----	-----	-----	-----	-----	-----	-----	3.90	30.36	10.34	40.70	.340	-----	-----	15.0	
381-----	7	5	-----	38.78	31.86	2.03	8.76	1.42	-----	-----	3.88	19.16	8.47	27.63	.442	-----	-----	10.9	
382-----	5	4	16.1	-----	-----	-----	-----	-----	-----	1.0	4.10	28.88	8.81	37.69	.306	.078	.015	8.9	
383-----	7	3	-----	-----	-----	-----	-----	-----	-----	-----	4.08	13.94	4.90	18.84	.352	-----	-----	8.7	
384-----	4	2	-----	-----	-----	-----	-----	-----	-----	-----	3.67	35.36	14.50	49.86	.412	-----	-----	11.5	
385-----	4	2	-----	-----	-----	-----	-----	-----	-----	-----	3.88	25.49	11.25	36.74	.443	-----	-----	22.2	
386-----	4	4	-----	-----	-----	-----	-----	-----	-----	-----	3.90	14.24	5.67	19.91	.397	-----	-----	6.3	
387-----	6	5	-----	-----	-----	-----	-----	-----	-----	-----	3.53	18.57	8.75	26.56	.428	-----	-----	7.8	
388-----	7	1	-----	-----	-----	-----	-----	-----	-----	-----	3.71	19.99	7.17	27.33	.425	-----	-----	8.8	
389-----	5	4	17.6	38.41	31.78	2.41	6.73	1.45	-----	1.6	3.82	14.08	5.81	20.49	.385	.061	.010	9.1	
390-----	4	8	-----	39.80	31.81	1.56	7.63	1.65	-----	1.4	3.85	14.85	5.87	20.80	.392	.061	.003	18.8	
391-----	4	6	16.1	-----	-----	-----	-----	-----	-----	-----	3.73	22.05	11.21	33.26	.308	.090	-----	16.9	
392-----	9	7	-----	38.56	32.56	5.12	5.51	.95	-----	.8	3.70	22.28	13.49	35.77	.006	-----	.028	9.1	
393-----	4	4	16.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Ave., 390-393.	6	4	16.5	38.89	32.00	2.78	7.16	1.37	-----	1.2	3.84	21.47	8.87	30.34	.415	.073	.014	11.9	

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
394.....	1957	.....	.....	.....	.....	.....	.....	.....
395.....	1956	Oct. 20.....	Palmetto, cabbage.....	.....	None.....	Liquid.....	Cecil W. Hoff, Eau Gallie, Fla.....	Eau Gallie, Ft. Pierce.
396.....	1956	August.....	.....do.....	.....	None.....	.....do.....	Vern Davis, Steinhatchee, Fla.....	Steinhatchee.
397.....	1957	.....	.....	.....	.....	.....do.....	A. T. Uzell, Moore Haven, Fla.....	Moore Haven.
398.....	1957	July.....	.....do.....	.....	.....	.....do.....	M. V. Cogshall, Minneola, Fla.....	Brevard County.
399.....	1957	July.....	Pentstemon.....	.....	None.....	Partly granulated.....	William E. Sornick, Gardiner, N. Y.....	Ulster County.
400.....	1956	.....	Pepperbush.....	.....	.....	Liquid.....	Justin Caswell, Middleboro, Mass.....	Middleboro.
401.....	1956	Aug. 5.....	Peppermint.....	.....	None.....	.....do.....	James Bunch, Sunnyside, Wash.....	Yakima area.
402.....	1956	Aug. 15.....	.....do.....	Strained, 5% alfalfa.....	Mildly.....	Granulated.....	Charles G. Becker, Outlook, Wash.....	Mapton, lower Yakima valley.
403.....	1956	June.....	Peppervine.....	.....	None.....	Liquid.....	Erwin Glew, Paris, Texas.....	Little River County, Ark.
404.....	1956	Aug. 15.....	Privet.....	.....	.....	.....do.....	W. Wortham Maxwell, San Antonio, Texas.....	San Antonio.
405.....	1957	June 27.....	.....do.....	.....	.....	.....do.....	Loren E. Vernon, Sonoma, Calif.....	Do, Healdsburg, Sonoma County.
406.....	1957	April.....	Prune.....	.....	.....	Soft granulation.....	Dudley Monroe, North Adams, Mich.....	Hillsdale.
407.....	1956	Nov. 6.....	Purple loosestrife.....	.....	None.....	Liquid.....	William E. Sornick, Gardiner, N. Y.....	Ulster County.
408.....	1957	August.....	.....do.....	.....	.....do.....	Granulated.....	M. Kushman, Cove City, N. C.....	Cove City.
409.....	1957	.....	.....do.....	.....	.....	Liquid.....	.....	.....

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg.	Meq./kg.	Meq./kg.		Percent	Percent	
394-----	6	0	17.4	10	38.19	29.49	0.76	9.58	1.56	-----	3.0	4.51	10.87	4.84	15.71	0.445	0.262	0.019	11.8
395-----	5	0	19.7	13	37.96	31.20	.63	6.25	.99	-----	3.6	3.61	37.62	6.97	44.94	.185	.084	.099	20.1
396-----	7	3	21.3	4	37.09	33.15	.52	4.07	.58	-----	3.3	3.80	28.27	8.81	37.08	.312	.143	.042	-----
Ave., 395-396	6	2	20.5	9	37.53	32.18	.58	5.16	.79	-----	3.5	3.69	32.95	7.89	41.01	.249	.114	.071	-----
397-----	6	2	15.1	7	37.40	30.88	.62	5.60	1.67	0.00	8.7	3.89	31.48	15.29	46.78	.485	.458	.019	21.1
398-----	7	1	18.0	8	39.07	30.96	1.04	7.36	1.70	.00	1.9	4.10	21.59	14.12	35.71	.654	.245	.024	7.7
Ave., 397-398	7	2	16.6	8	38.24	30.92	.83	6.48	1.69	-----	5.3	3.98	26.54	14.71	41.25	.570	.352	.022	14.4
399-----	4	2	17.1	8	39.35	32.21	.68	6.93	.98	-----	2.7	3.98	17.54	7.23	24.78	.412	.063	.036	-----
400-----	8	4	17.8	12	36.30	31.30	.81	7.11	1.63	-----	5.0	4.18	21.85	10.18	32.03	.465	.235	.053	12.0
401-----	8	4	16.4	10	41.98	31.16	.56	6.84	.78	-----	2.3	4.74	28.16	3.20	31.26	.114	.385	.042	17.1
402-----	10	5	16.5	14	42.23	30.91	.45	5.89	.99	-----	3.0	4.68	40.06	3.12	43.18	.078	.561	.047	-----
Ave., 401-402	9	5	16.5	12	42.11	31.04	.51	6.37	.89	-----	2.7	4.71	34.11	3.16	37.22	.096	.473	.045	-----
403-----	10	0	17.8	18	36.20	25.32	.98	13.51	1.92	.56	3.7	3.92	23.98	8.35	32.33	.348	.148	.017	6.7
404-----	9	-----	16.7	16	38.71	27.97	.80	6.60	.51	.69	8.0	3.80	40.73	18.76	59.49	.461	.191	.048	-----
405-----	4	3	16.6	19	38.53	32.77	1.50	8.35	.74	-----	1.5	3.58	28.94	14.77	43.71	.510	.120	.055	-----
Ave., 404-405	7	3	16.7	18	38.62	30.37	1.15	7.48	.63	-----	4.8	3.68	34.84	16.77	51.60	.486	.156	.052	-----
406-----	8	6	19.4	15	36.94	28.09	.42	10.47	.77	-----	3.9	6.10	11.80	.00	11.80	.000	.694	.095	-----
407-----	6	4	18.6	8	38.51	31.34	.31	5.87	1.57	-----	3.8	3.88	21.91	9.36	31.27	.427	.083	.049	-----
408-----	7	1	17.1	7	37.93	30.82	.71	8.02	2.27	-----	3.1	4.38	23.49	6.63	30.12	.282	.231	.049	-----
409-----	1	0	19.1	21	36.82	27.54	.84	10.51	3.21	.78	1.2	3.52	17.88	7.30	25.18	.408	.062	.034	30.6
Ave., 407-409	5	2	18.3	12	37.75	29.90	.62	8.13	2.35	-----	2.7	3.80	21.09	7.76	28.86	.372	.125	.044	-----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
410.....	1957	Aug. 1.....	Raspberry.....	.....	None.....	Crystals.....	W. E. Lyman, Greenwich, N.Y.....	Hamilton and Frank- lin Counties.
411.....	1957	Aug. 1.....	do.....	.....	130° for 20 min., 20'' vacuum.	Liquid.....	do.....	Do.
412.....	1956	.....	do.....	Strained.....	140°.....	Crystals.....	George H. Dale, New Britain, Pa.....	Bucks County.
413.....	1957	.....	do.....	do.....	140°.....	Liquid.....	do.....	Do.
414.....	1957	.....	Rhododendron.....	Poisonous (acetylan- dromedol found in sample) (in comb).	None.....	do.....	Raymond Presnell, Banner Elk, N.C.	Watauga County.
415.....	1957	.....	Rosinweed.....	.....	.....	do.....	Ralph Wilson, Belmond, Iowa.....	Belmond.
416.....	1957	Sept. 6.....	do.....	.....	.....	Solid granulation.....	Harry J. Rodenberg, Wolf Point, Mont.	Wolf Point.
417.....	1956	June 30.....	Sage.....	Strained.....	110°.....	Partly granulated.....	William Ross, Valyermo, Calif.....	Los Angeles County.
418.....	1956	June.....	do.....	.....	None.....	Granulated.....	L. G. Gear, Los Banos, Calif.....	Salinas, Monterey County.
419.....	1957	.....	do.....	Strained.....	To strain.....	Liquid.....	E. S. Bostwick, Chowchilla, Calif.....	Monterey County.
420.....	1957	.....	Sage-wild buck- wheat.	.....	.....	Soft granulation.....	I. C. Anderson, Lemon Grove, Calif.	San Diego County.
421.....	1957	Aug. 1.....	Sage, white-wild alfalfa.	.....	None.....	do.....	Charles D. Morse, Lakeside, Calif.....	Barona Indian Reser- vation, San Diego County.
422.....	1957	.....	Salt cedar-nat- ural fall blend.	Catsclaw, cotton, mesquite.	Some.....	Solid granulation.....	W. A. Burnham, Phoenix, Ariz.....	Litchfield.
423.....	1956	July.....	Snowbrush.....	In comb.....	None.....	Liquid.....	C. G. Wenner, Glenn, Calif.....	Mt. Lassen, 5,500- 7,000 ft.
424.....	1956	.....	Sourwood.....	Unstrained.....	do.....	do.....	Max A. Culp, Lenoir, N.C.....	Lenoir, Caldwell County.
425.....	1956	.....	do.....	In comb.....	do.....	do.....	Raymond Presnell, Shulls Mills, N.C.	Shulls Mills.
426.....	1957	.....	do.....	.....	do.....	do.....	M. C. Ludlam, Lynchburg, Va.....	Amherst County.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meg./kg.	Meg./kg.	Meg./kg.		Percent	Percent	
410.....	4	1	18.0	9	40.64	31.46	0.73	6.45	0.94	-----	1.8	3.72	21.53	6.74	28.27	0.313	0.102	0.032	14.0
412.....	10	0	17.2	27	35.50	28.57	.51	11.05	1.62	-----	5.6	4.18	34.32	6.11	40.43	.178	.283	.087	-----
413.....	10	0	16.9	15	27.25	25.60	.29	8.54	8.18	-----	13.2	4.75	45.06	3.81	48.87	.085	1.028	.108	-----
Ave., 410-413.	8	0	17.4	17	34.46	28.54	.51	8.68	3.58	-----	3.5	4.04	33.64	5.55	39.19	.192	.471	.076	-----
414.....	0	0	16.1	5	33.62	26.49	.52	12.97	2.44	-----	7.9	4.78	8.18	1.97	10.15	.240	.179	.028	39.0
415.....	4	0	18.3	12	39.64	31.03	.70	6.77	.63	-----	2.9	3.88	25.56	7.70	33.26	.301	.105	.044	55.6
416.....	6	5	16.5	12	39.39	33.84	.80	5.67	.80	-----	3.0	3.80	24.84	8.86	33.70	.357	.157	.057	-----
Ave., 415-416.	5	3	17.4	12	39.52	32.44	.75	6.22	.72	-----	3.0	3.84	25.20	8.28	33.48	.329	.131	.051	-----
417.....	5	2	17.2	14	38.69	29.47	.94	6.81	1.39	-----	5.5	3.78	21.19	11.00	32.19	.519	.100	.041	-----
418.....	6	2	16.9	15	40.69	30.06	1.06	6.88	1.15	-----	3.3	3.90	24.27	10.65	34.92	.440	.140	.048	-----
419.....	1	0	14.0	15	41.78	25.05	1.39	8.52	4.61	0.47	4.2	3.75	14.25	5.93	20.18	.416	.085	.022	-----
Ave., 417-419.	4	1	16.0	15	40.39	28.19	1.13	7.40	2.38	-----	4.3	3.81	19.90	9.19	29.10	.458	.108	.037	-----
420.....	7	2	16.4	16	38.86	28.76	.84	8.40	1.01	.51	5.2	3.87	28.00	9.33	37.33	.333	.137	.067	-----
421.....	6	4	16.9	14	37.36	28.61	.86	10.07	1.56	.83	3.8	3.95	23.77	6.97	30.74	.293	.158	.059	-----
422.....	8	9	14.0	10	40.25	36.61	2.41	4.43	.39	.00	1.9	4.12	30.15	9.73	39.88	.323	.352	.059	-----
423.....	6	1	13.7	14	37.81	30.95	1.35	8.84	3.22	-----	4.1	3.88	38.23	7.46	45.69	.195	.187	.059	34.5
424.....	6	0	17.8	15	39.20	25.23	.85	11.38	2.29	-----	3.2	4.47	14.92	5.14	20.06	.344	.259	.014	15.6
425.....	7	0	16.9	15	39.45	23.12	.93	13.53	3.02	-----	3.0	4.50	10.75	3.91	14.66	.363	.215	.019	8.6
426.....	3	0	16.6	7	40.73	25.48	.97	10.47	2.35	.00	3.4	4.65	14.89	1.23	16.13	.083	.217	.026	21.7
Ave., 424-426.	5	0	17.1	12	39.79	24.61	.92	11.79	2.55	-----	3.2	4.53	13.52	3.43	16.95	.263	.230	.020	15.3

See footnote at end of table.

TABLE 26.—Source and description of honey samples—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
427.....	1957	-----	Sourwood-clover..	From east Tennessee foothills.	-----	Liquid.....	Roy D. Brown, Del Rio, Tenn.....	Cocke County.
428.....	1957	-----	Sourwood-sumac..	Also white clover (in comb).	None.....	do.....	Bruce Anderson, Chatham, Va....	Chatham.
429.....	1957	-----	Spanish needle..	-----	-----	Crystals.....	Frank Fekel, Vineland, N.J.....	Bridgeport.
430.....	1956	Oct. 15.....	Spanish needle-heartsease.	-----	-----	Liquid.....	James S. Messner, Bareville, Pa....	New Jersey, 1 mile south of Chester Ferry.
431.....	1957	Sept. 15.....	do.....	-----	-----	do.....	M. O. Raley, Paragould, Ark.....	Paragould.
432.....	1957	-----	Spearmint.....	-----	-----	Beginning to granulate.	James E. Bunch, Sunnyside, Wash.	Sunnyside.
433.....	1956	Oct. 15.....	Sumac.....	Scraped from comb.....	None.....	Partly granulated.....	P. J. Hewitt, Jr., Litchfield, Conn.	Litchfield.
434.....	1957	-----	Sumac-white clover.	Some honeydew.....	do.....	Liquid.....	Bruce Anderson, Chatham, Va....	Chatham.
435.....	1956	July 18.....	Sumac, staghorn-clover.	-----	do.....	do.....	Arthur G. Strang, Silver Spring, Md.	Linden, Va.
436.....	1957	October.....	Sunflower, wild.....	-----	-----	Few crystals.....	M. V. Coggs, Minneola, Fla....	Hendry County.
437.....	1957	Sept. 16.....	Tallowtree-peppervine.	Not ripe (in comb).....	None.....	Liquid.....	J. P. Eckles, Baton Rouge, La....	Jeff Davis Parish.
438.....	1957	-----	Thistle, blue.....	-----	-----	do.....	Walter Witherell, Westhampton, Mass.	Lake Champlain area, N.Y.
439.....	1957	-----	Thistle, blue-clover.	-----	None.....	Soft granulation.....	A. D. Hiatt, Martinsburg, W. Va..	Martinsburg.
440.....	1956	Aug. 20.....	Thistle, star.....	Strained.....	130°.....	Liquid.....	Jess Gentry, Oakdale, Calif.....	Stanislaus County.
441.....	1956	Sept. 10.....	do.....	-----	None.....	Granulated.....	Leo I. Wenner, Hamilton City, Calif.	Hamilton City.
442.....	1957	Aug. 15.....	do.....	-----	-----	Liquid.....	Lloyd Fox, Fair Oaks, Calif.....	Sacramento Valley.
443.....	1957	August.....	do.....	-----	-----	Solid granulation.....	Loren E. Vernon, Sonoma, Calif..	Sonoma.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg.	Meq./kg.	Meq./kg.		Percent	Percent	
427-----	8	0	17.4	15	34.23	25.42	0.86	13.54	2.29	-----	6.3	4.35	33.37	8.98	42.34	0.269	0.460	0.058	22.2
428-----	7	0	17.7	6	39.30	26.40	.90	9.71	1.74	-----	4.2	4.48	18.71	5.80	24.51	.310	.262	.036	36.4
429-----	7	0	18.3	10	41.65	26.69	.89	7.84	.96	-----	3.7	3.90	31.19	12.93	44.11	.415	.245	.081	-----
430-----	8	1	16.6	11	41.86	29.49	.60	6.72	1.47	-----	3.3	4.05	27.53	11.11	38.64	.404	.194	.059	32.6
431-----	7	1	17.3	7	39.74	31.01	.65	6.94	1.51	-----	2.8	4.20	23.87	8.39	32.26	.352	.243	.057	43.5
Ave., 430-431	8	1	17.0	9	40.80	30.25	.63	6.83	1.49	-----	3.1	4.12	25.70	9.75	35.45	.378	.219	.058	38.0
432-----	6	3	16.6	6	41.09	32.58	.43	5.98	.65	-----	2.7	4.30	32.76	5.67	38.43	.173	.313	.045	-----
433-----	10	2	17.6	9	31.46	24.39	1.77	8.21	6.90	-----	9.7	4.42	37.74	6.36	44.10	.168	.931	.056	34.1
434-----	8	0	17.5	7	37.79	26.03	.77	10.17	2.43	-----	5.3	4.56	26.91	5.41	32.32	.201	.326	.022	-----
435-----	6	1	17.7	14	36.82	27.89	.63	9.86	2.59	-----	4.5	4.25	22.68	4.16	26.84	.184	.203	.047	24.0
436-----	8	0	20.5	14	37.96	31.13	.89	6.64	1.04	0.35	1.5	3.90	29.17	10.38	39.55	.256	.154	.077	13.3
437-----	9	1	17.2	7	35.74	34.65	.88	6.51	.98	-----	4.0	3.69	29.67	10.70	40.37	.361	.132	.051	23.6
438-----	2	1	16.4	17	37.30	31.27	1.28	8.43	2.53	.38	2.4	3.88	11.81	4.69	16.50	.397	.039	.033	-----
439-----	6	0	18.8	21	37.00	29.84	.76	7.36	1.80	.62	3.8	3.80	28.29	11.23	39.46	.397	.147	.063	-----
440-----	3	1	13.4	12	36.41	29.63	5.24	6.85	3.46	.98	4.0	3.61	21.13	12.37	33.50	.586	.056	.046	29.4
441-----	6	7	15.9	12	37.08	34.54	1.08	6.53	2.08	-----	2.8	3.73	36.01	13.70	49.71	.380	.121	.069	-----
442-----	3	1	17.3	9	36.98	31.91	1.53	6.87	2.76	.00	2.6	3.30	31.14	17.40	48.54	.559	.080	.055	36.4
443-----	4	1	16.8	12	37.16	28.47	1.24	7.44	2.66	-----	6.2	3.68	22.41	12.44	34.85	.555	.130	.051	-----
Ave., 440-443	4	3	15.9	11	36.91	31.14	2.27	6.92	2.74	-----	3.9	3.54	27.67	13.98	41.65	.520	.097	.055	32.9

See footnote at end of table.

TABLE 26.—*Source and description of honey samples—Continued*

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
444.....	1956	August.....	Thistle, star-ladino clover.	Half and half, not strained.	None.....	Granulated.....	William C. Koehnen, Glenn, Calif.	Glenn County.
445.....	1957	-----	Thistle star-honeydew.	Very dry season.....	-----	Liquid.....	Xavier Widmer, Medford, Oreg.	Medford.
446.....	1957	-----	Thyme.....	From Finger Lakes Co-operative, Groton, N.Y.	-----	Crystals.....	-----	Catskill Mountains, N.Y.
447.....	1957	-----	Titi.....	-----	None.....	Granulated.....	Paul Cutts, Chipley, Fla.	Chipley.
448.....	1956	-----	Titi, spring	-----	do.....	Soft granulation.....	Wm. W. Wicht, Hattiesburg, Miss.	Hattiesburg.
449.....	1956	Aug. 10.....	Trefoil, birdsfoot-vetch.	75-85% birdsfoot trefoil.	do.....	Beginning to granulate.	Charles Mraz, Middlebury, Vt.	Addison County.
450.....	1956	-----	Trefoil, birdsfoot-clover.	Small amounts of red and sweet clover (WSC Apiary).	-----	do.....	Carl A. Johansen, Pullman, Wash.	Pullman.
451.....	1957	Aug. 1.....	Tulip tree.....	-----	None.....	Liquid.....	Thomas H. Litz, Baltimore, Md.	Baltimore County.
452.....	1957	July 4.....	do.....	-----	do.....	do.....	Arthur G. Strang, Silver Spring, Md.	Gaithersburg.
453.....	1957	-----	do.....	From mountains.....	-----	do.....	Roy D. Brown, Del Rio, Tenn.	Coeke County.
454.....	1957	-----	do.....	-----	-----	do.....	Allen D. Brooks, Charlestown, Ind.	Charlestown.
455.....	1956	-----	Tulip tree-basswood.	-----	-----	do.....	A. J. Elsner, Flourtown, Pa.	Lehigh County.
456.....	1956	July.....	Tulip tree-clover.	-----	Heated.....	do.....	Mrs. A. Storm, Maple Glen, Pa.	Maple Glen.
457.....	1957	-----	do.....	-----	-----	do.....	D. A. Wyrosdick, Knoxville, Tenn.	Knox County.
458.....	1957	-----	Tulip tree-honeydew.	Also white clover (in comb).	None.....	do.....	Bruce Anderson, Chatham, Va.	Chatham.
459.....	1956	July.....	Tulip tree-natural spring blend.	Miscellaneous wild flowers.	-----	do.....	James S. Messner, Bareville, Pa.	Lionville, Chester County.
460.....	1956	-----	do.....	Clover, vetch, berries (in comb, NCSC, Apiary).	None.....	do.....	W. A. Stephen, Raleigh, N.C.	Raleigh.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
444-----	7	5	Percent 16.6	Months 13	Percent 36.89	Percent 33.07	Percent 0.99	Percent 6.12	Percent 1.87	Percent -----	Percent 4.5	3.70	Meq./kg. 37.28	Meq./kg. 14.74	Meq./kg. 52.02	0.394	Percent 0.117	Percent 0.064	-----
445-----	8	3	15.2	7	36.68	28.46	.68	9.63	2.93	0.00	6.4	4.69	34.33	5.39	39.72	.157	.450	.082	41.4
446-----	8	1	16.8	20	37.13	31.20	.85	8.83	1.70	.34	3.2	4.80	22.41	5.47	27.88	.244	.384	.057	-----
447-----	9	2	17.7	6	39.23	31.78	.50	7.01	.46	.00	3.3	4.60	17.16	2.05	19.21	.120	.287	.006	16.5
448-----	7	1	17.5	33	40.85	25.95	1.30	7.43	1.37	-----	5.6	4.41	16.88	1.95	18.83	.116	.144	.040	-----
449-----	1	2	15.5	10	38.16	31.44	2.15	7.98	2.80	-----	2.0	3.90	13.56	5.04	18.60	.372	.026	.029	10.3
450-----	4	1	13.8	9	40.76	31.33	1.48	9.18	1.52	-----	1.9	4.09	11.35	4.27	15.62	.346	.042	.028	15.0
451-----	8	0	17.4	5	35.54	27.35	.60	9.63	2.19	-----	7.3	4.65	26.15	2.30	28.45	.088	.308	.052	-----
452-----	10	0	16.9	14	32.74	23.08	.14	14.64	4.23	-----	8.3	4.63	42.68	4.24	46.93	.099	.620	.091	33.3
453-----	11	0	17.9	15	34.19	25.79	.89	11.92	2.99	-----	6.3	4.21	39.06	7.10	46.16	.182	.420	.063	18.5
454-----	11	0	18.2	18	36.11	27.18	1.11	10.08	2.44	.29	4.6	4.45	45.24	5.18	50.43	.115	.492	.098	13.2
Ave., 451-454	10	0	17.6	13	34.65	25.85	.69	11.57	2.96	-----	6.6	4.45	38.28	4.71	42.99	.121	.460	.076	21.7
455-----	8	0	16.1	11	34.08	27.32	.90	11.47	2.93	-----	7.2	4.84	26.46	4.34	30.80	.164	.438	.072	30.0
456-----	10	0	15.8	12	35.32	27.69	.79	9.48	2.13	-----	8.8	4.60	44.20	3.14	47.34	.071	.435	.116	33.7
457-----	10	1	16.9	14	31.67	22.03	.90	15.37	4.15	.67	8.3	4.70	47.19	3.81	51.00	.075	.755	.102	42.9
Ave., 456-457	10	1	16.4	13.	33.50	24.86	.85	12.43	3.14	-----	8.6	4.65	45.70	3.48	49.17	.073	.595	.109	38.3
459-----	10	9	15.8	14	31.97	32.63	.95	6.87	4.41	-----	7.4	-----	-----	-----	-----	-----	.152	.027	14.4
460-----	10	0	16.5	17	36.33	25.30	.78	12.13	2.74	-----	6.2	4.54	37.15	3.47	40.62	.094	.428	.078	17.6
Ave., 459-460	10	5	16.2	16	34.15	28.97	.87	9.50	3.58	-----	6.8	4.54	37.15	3.47	40.62	.094	.290	.053	16.0

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
461.....	1957	-----	Tulip tree-summer blend.	Clover and swamp sources.	-----	Partly granulated..	Frank Fekel, Vineland, N.J.....	Quinton.
462.....	1957	-----	Tupelo.....	Purchased by Coggsball.	-----	Liquid.....	-----	W. Florida.
463.....	1957	-----	..do.....	-----	-----	..do.....	J. A. Glenn, Wewahitchka, Fla.....	Wewahitchka.
464.....	1957	-----	..do.....	-----	-----	..do.....	R. R. Davis, Wewahitchka, Fla.....	Do.
465.....	1957	-----	..do.....	-----	-----	..do.....	Homer Coe, Wewahitchka, Fla.....	Do.
466.....	1957	-----	..do.....	-----	-----	..do.....	Joe Whitfield, Wewahitchka, Fla.....	Do.
467.....	1957	-----	..do.....	-----	-----	..do.....	Carl Culbreath, Apalachicola, Fla.....	Apalachicola.
468.....	1956	-----	Unknown.....	In comb, deep blue color.	None.....	..do.....	Dan S. Moss, Enfield, N.C.....	Halifax County.
469.....	1956	June.....	Vetch.....	-----	160°.....	Granulated.....	C. G. Wenner, Glenn, Calif.....	Petalum.
470.....	1956	May.....	..do.....	-----	-----	..do.....	Loren Vernon, Sonoma, Calif.....	Sonoma County.
471.....	1957	July 15.....	..do.....	-----	-----	Liquid.....	M. O. Raley, Paragould, Ark.....	Paragould.
472.....	1957	-----	..do.....	In comb.....	None.....	..do.....	William M. Perry, McMinnville, Oreg.....	McMinnville.
473.....	1957	-----	..do.....	Produced in May.....	-----	..do.....	Lloyd Fox, Fair Oaks, Calif.....	Sacramento Valley.
474.....	1957	June.....	..do.....	-----	None.....	Partly granulated.....	J. Oren Kane, Banks, Oreg.....	Polk County.
475.....	1957	May.....	..do.....	-----	-----	Soft granulation.....	Loren E. Vernon, Sonoma, Calif.....	Santa Rosa, Sonoma County.
476.....	1957	Spring.....	Vetch-birdsfoot trefoil.	-----	-----	Granulated.....	Delmar L. Smith, Central Point, Oreg.....	Central Point.
477.....	1956	-----	Vetch, hairy.....	Unstrained.....	-----	Liquid.....	Hugh O. Walker, Tulsa, Okla.....	Tulsa County.
478.....	1956	July.....	..do.....	-----	None.....	..do.....	Erwin Glew, Paris, Tex.....	Lamar County.
479.....	1957	June 14.....	..do.....	From new combs, unstrained.	..do.....	..do.....	S. J. Head, Mer Rouge, La.....	Morehouse Parish.
480.....	1957	-----	..do.....	-----	..do.....	Partly granulated.....	J. W. Wright, Newburg, Oreg.....	Newburg.
481.....	1957	-----	..do.....	-----	-----	Liquid.....	John Bean, Leoma, Tenn.....	Leoma.
482.....	1957	-----	..do.....	Nearly pure uncapped and drained.	Below 100°.....	..do.....	W. D. Haskell, Portland, Oreg.....	Portland.
483.....	1957	June.....	..do.....	-----	None.....	Scattered crystals.....	Oliver Petty, Albany, Oreg.....	Monmouth, Polk County.
484.....	1957	..do.....	..do.....	-----	Yes.....	Small crystals.....	..do.....	Do.
485.....	1957	July 10.....	..do.....	Unstrained; traces of bachelor buttons and blackberry.	None.....	Soft granulation.....	..do.....	Do.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg.	Meq./kg.	Meq./kg.		Percent	Percent	
461-----	8	2	17.8	8	38.47	30.26	0.70	7.53	0.95	-----	4.3	4.60	24.51	6.29	30.80	0.253	0.361	0.058	-----
462-----	6	0	18.4	10	42.25	29.37	.94	6.89	1.22	0.00	.9	4.09	20.41	9.86	30.27	.483	.149	.029	15.8
463-----	8	0	18.0	19	43.83	25.55	1.31	7.53	1.16	-----	2.6	3.80	30.58	14.56	45.14	.476	.140	.060	18.6
464-----	7	0	17.4	19	44.26	23.83	1.30	8.31	1.20	-----	3.7	3.83	25.87	12.75	38.62	.493	.108	.045	17.1
465-----	7	0	18.3	19	42.98	25.42	1.29	8.53	1.05	-----	2.4	3.98	24.54	8.03	32.57	.327	.128	.046	18.1
466-----	7	0	18.5	19	42.52	25.59	1.24	8.24	.82	-----	3.1	3.80	27.93	13.11	41.05	.470	.129	.051	19.1
467-----	6	0	18.4	19	43.80	25.91	1.17	8.31	1.22	-----	1.2	3.81	23.44	8.43	31.87	.360	.113	.047	18.1
Ave., 462-467-	7	0	18.2	18	43.27	25.95	1.21	7.97	1.11	-----	2.3	3.87	25.46	11.12	36.59	.435	.128	.046	17.8
468-----	12	0	19.6	12	34.97	24.18	.91	10.72	3.40	-----	6.2	4.20	25.47	8.76	34.23	.344	.267	.049	-----
469-----	3	6	16.6	15	37.75	33.13	1.62	7.09	1.46	-----	2.3	3.55	21.58	10.60	32.18	.489	.055	.031	16.9
470-----	4	6	17.7	17	39.34	33.07	.63	5.92	1.23	-----	2.1	3.92	15.73	8.30	24.03	.529	.096	.035	21.7
471-----	5	2	18.2	9	37.85	32.11	.98	6.21	1.58	.56	2.5	3.80	24.96	11.24	36.20	.450	.135	.023	21.1
472-----	0	0	16.9	9	38.29	28.48	1.88	8.79	2.64	-----	3.0	3.72	17.76	10.48	28.24	.590	.071	.029	5.9
473-----	4	1	15.7	12	38.38	31.90	1.39	7.65	2.01	-----	3.0	3.45	29.16	14.50	43.66	.497	.119	.056	-----
474-----	1	1	16.7	11	38.98	31.27	1.57	7.52	2.27	.00	1.7	3.66	15.20	3.99	19.20	.263	.055	.026	-----
475-----	4	4	17.4	15	37.69	31.70	1.32	7.46	1.63	-----	2.8	3.90	18.83	8.69	27.53	.462	.130	.034	-----
Ave., 469-475-	3	3	17.0	13	38.33	31.67	1.34	7.23	1.83	-----	2.5	3.68	20.46	9.69	30.15	.469	.094	.033	16.4
476-----	6	4	15.9	20	37.35	32.18	1.69	6.26	1.34	.00	5.3	3.80	28.13	13.55	41.68	.482	.127	.079	-----
477-----	6	9	15.8	12	38.41	32.86	2.11	6.12	1.64	-----	3.1	3.70	22.48	10.68	33.16	.475	.081	.044	6.1
478-----	1	1	15.9	17	38.46	30.60	.96	8.98	2.29	.56	2.2	3.80	11.25	5.92	17.17	.527	.038	.017	10.0
479-----	1	4	19.1	1	37.34	32.30	1.59	4.66	1.65	-----	3.4	3.61	22.58	10.64	33.22	.476	.061	.035	24.2
480-----	2	1	15.8	8	38.48	30.58	2.01	7.73	2.34	.00	3.1	3.89	14.36	8.64	23.00	.602	.043	.024	-----
481-----	1	1	17.2	13	40.34	25.51	1.17	10.95	2.18	1.09	1.6	4.00	11.69	2.45	14.14	.210	.048	.026	11.3
482-----	1	1	16.8	16	37.90	29.37	1.60	9.40	2.43	-----	2.5	3.73	12.44	4.68	17.12	.376	.066	.023	-----
483-----	1	1	16.1	19	36.55	30.21	5.48	7.39	2.78	.91	.6	3.70	14.42	8.02	22.44	.556	.039	.027	-----
484-----	1	0	15.2	19	39.11	33.17	1.10	6.57	.64	-----	4.2	3.62	13.66	8.68	22.31	.635	.100	.037	-----
485-----	2	1	15.0	18	37.22	31.16	2.25	8.49	2.74	.98	2.2	3.70	16.72	7.88	24.60	.471	.025	.036	-----
Ave., 477-485-	2	2	16.3	14	38.20	30.64	2.03	7.81	2.08	-----	2.5	3.73	15.51	7.51	23.02	.481	.056	.030	12.9

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
486.....	1956	-----	Vetch, hairy-natural blend.	Also fruit trees and cucumbers.	Liquid.....	-----	John T. Harley, Tulsa, Okla.....	Creek County.
487.....	1956	-----	Vetch, milk-dandelion.	-----	115°.....	Complete coarse granulation.	J. W. Holzberlein, Meeker, Colo..	Meeker.
488.....	1956	-----	Willow, black.	-----	150°.....	Liquid.....	E. C. Bessonnet, Donaldsonville, La.	Donaldsonville.
489.....	1957	May.....	Willow.....	-----	None.....	do.....	Erwin Glew, Paris, Tex.....	Chicot County, Ark.
490.....	1956	-----	Wing stem-lespedeza.	In comb.....	do.....	do.....	L. H. Little, Shelbyville, Tenn...	Shelbyville.
491.....	1956	July.....	Winter cress	-----	135°.....	do.....	H. R. Swisher, Springfield, Ohio..	Clark County.
492.....	1956	September..	Honeydew, alfalfa.	Honeydew from spotted alfalfa aphid on alfalfa.	None.....	Granulated	W. E. Riggles, Delhi, Calif.....	Hilmar.
493.....	1957	-----	Honeydew, cedar.	Sierra Nevada Mts., 4,000 ft.	-----	Liquid.....	Lloyd Fox, Fair Oaks, Calif.....	Northern Calif.
494.....	1957	October.....	do.....	Scraped from capped comb, strained.	Warmed.....	do.....	A. R. Banta, Los Molinos, Calif..	Viola, Shasta County.
495.....	1957	-----	do.....	Elevation 2,800 ft.....	110°.....	Solid granulation	C. G. Wenner, Glenn, Calif.....	Manton, Tehama County.
496.....	1956	Oct. 15.....	Honeydew, hickory.	-----	None.....	Partly granulated	P. J. Hewitt, Jr., Litchfield, Conn.	Litchfield.
497.....	1956	Oct. 5.....	Honeydew, oak	-----	do.....	Granulated	Leo I. Wenner, Hamilton City, Calif.	Paskereta.
498.....	1957	-----	do.....	-----	do.....	Liquid.....	Cecil W. Hoff, Eau Gallie, Fla....	Eau Gallie.
499.....	1957	-----	do.....	Produced in August	-----	do.....	Lloyd Fox, Fair Oaks, Calif.....	Sacramento Valley.
500.....	1957	September..	do.....	Elevation 5,000 ft.....	120°.....	Soft granulation	C. G. Wenner, Glenn, Calif.....	Mt. Lassen area, Shasta County.
501.....	1957	Fall.....	do.....	-----	-----	Granulated	Delmar L. Smith, Central Point, Oreg.	Central Point.

See footnote at end of table.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
			Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg.	Meq./kg.	Meq./kg.		Percent	Percent	
486.....	7	4	18.6	12	37.82	31.08	0.62	7.64	1.59	-----	2.8	4.12	20.21	5.52	25.73	0.273	0.134	0.048	22.2
487.....	6	4	16.1	3	38.73	36.25	.25	5.44	.90	-----	2.3	4.59	12.70	1.91	14.61	.150	.160	.048	12.2
488.....	6	6	17.2	13	42.60	33.55	.86	4.51	.14	-----	.9	4.20	14.62	3.78	18.40	.258	.072	.030	9.8
489.....	7	2	18.5	7	38.99	31.46	1.09	6.21	.81	-----	2.9	3.89	19.69	5.96	25.65	.302	.115	.026	-----
Ave., 488-489.	7	4	17.9	10	40.80	32.51	.98	5.36	.48	-----	1.9	4.02	17.16	4.87	22.03	.280	.094	.028	-----
490.....	7	0	17.2	10	38.31	28.24	1.15	8.62	1.53	0.68	5.0	4.10	19.08	7.66	26.74	.401	.128	.051	21.4
491.....	7	2	19.5	16	37.02	32.25	1.11	5.75	.67	-----	3.7	3.70	21.68	8.26	29.94	.380	.057	.016	-----
492.....	11	6	17.8	12	35.12	31.86	.68	5.51	2.12	-----	6.9	4.25	53.48	3.84	57.32	.072	.480	.149	31.3
493.....	11	1	12.2	9	23.91	23.34	.83	5.85	11.50	.00	22.4	4.42	66.02	10.47	76.49	.159	1.097	.049	-----
494.....	10	1	15.2	18	26.22	27.94	.74	6.08	8.70	-----	15.1	4.71	49.91	6.16	56.07	.123	1.047	.047	-----
Ave., 493-494.	11	1	13.7	14	25.07	25.64	.79	5.97	10.10	-----	18.7	4.54	57.97	8.32	66.28	.141	1.072	.048	-----
495.....	10	2	16.0	16	25.36	26.49	.46	6.66	8.64	-----	16.4	4.50	49.90	7.36	57.26	.148	.859	.049	-----
496.....	10	1	15.3	9	31.10	23.89	1.02	8.96	7.78	3.56	8.4	4.70	23.76	3.99	37.75	.118	.670	.046	-----
497.....	9	1	14.7	11	33.38	28.61	.68	10.96	2.43	-----	9.0	4.70	49.84	2.00	51.84	.040	.522	.133	-----
498.....	12	1	18.2	8	38.12	29.51	1.14	8.67	1.28	.38	2.7	3.90	36.62	14.09	50.71	.385	.212	.053	6.7
499.....	10	0	16.2	9	34.59	26.61	.63	10.59	2.47	-----	8.9	4.70	64.57	2.58	67.27	.040	.799	.223	41.4
500.....	10	2	17.7	16	33.70	27.20	1.01	10.99	2.81	.00	6.6	4.80	47.80	5.23	53.04	.109	.758	.126	-----
501.....	9	2	17.9	18	34.42	25.24	.75	11.06	1.81	-----	8.8	4.40	56.24	6.16	62.40	.110	.603	.098	-----
Ave., 497-501.	10	1	16.9	12	34.84	27.43	.84	10.45	2.16	-----	7.2	4.35	51.01	6.01	57.05	.137	.579	.127	-----

See footnote at end of table.

TABLE 26.—*Source and description of honey samples*—Continued

Sample No.	Year	Removed	Floral type	Comments ¹	Producer's heating, ° F.	Condition on receipt	Name and address of producer	Area produced
502.....	1956	Oct. 1.....	Honeydew, oak-star thistle.	From foothills.....	110°.....	Granulated.....	C. G. Wenner, Glenn, Calif.....	West of Corning.
503.....	1956	Early August.	Honeydew.....	Largest honeydew flow on record here (in comb).	None.....	Liquid.....	Robert M. Mead, White River Junction, Vt.	White River Junction.
504.....	1956	August.....	.....do.....	In comb.....	.....do.....	Granulated.....	Arthur G. Strang, Silver Spring, Md.	Fauquier County, Va.
505.....	1957	Summer.....	.....do.....	.....do.....	.....do.....	Liquid.....	William Thompson, Lenoir, N.C.	Lenoir, Caldwell County.

¹ Comments in parentheses are authors; others are producers.

TABLE 27.—Composition of honey samples and averages of selected groups—Continued

Sample No.	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Meleztose	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen	Dia-stase
502.....	10	0	Percent 14.6	Months 11	Percent 34.48	Percent 25.73	Percent 0.99	Percent 11.11	Percent 3.72	Percent 0.40	Percent 9.4	4.88	Meg./kg. 53.62	Meg./kg. 0.36	Meg./kg. 53.98	0.007	Percent 0.711	Percent 0.133	-----
503.....	8	3	18.2	12	33.05	25.12	1.05	9.16	5.57	.95	6.9	4.58	30.29	4.33	34.62	.143	.468	.058	48.4
504.....	10	8	17.3	15	28.94	19.23	.44	5.11	2.82	13.43	11.1	4.30	41.00	8.96	49.96	.219	1.185	.108	-----
505.....	12	0	16.4	8	32.82	24.41	.79	12.48	4.10	.00	9.0	4.80	53.95	5.68	59.63	.105	.890	.124	-----
Ave., 504-505.	10	4	17.3	12	31.60	22.92	.76	8.92	4.16	-----	9.0	4.51	41.75	6.32	48.07	.156	.848	.097	-----
ALL HONEY (490 SAMPLES)																			
Average....	5	3	17.2	12	38.19	31.28	1.31	7.31	1.50	-----	3.1	3.91	22.03	7.11	29.12	.335	.169	.041	-----
ALL HONEYDEW (14 SAMPLES)																			
Average....	10	2	16.3	12	31.80	26.08	.80	8.80	4.70	-----	10.1	4.45	49.07	5.80	54.88	.127	.736	.100	-----
ALL HONEY AND HONEYDEW (504 SAMPLES)																			
Average....	5	3	17.2	12	38.00	31.13	1.30	7.35	1.60	-----	3.3	3.92	22.80	7.07	29.85	.329	.186	.043	² 20.6
ALL 1956 HONEY (191 SAMPLES)																			
Average....	6	4	17.0	14	37.92	31.15	1.32	7.44	1.69	-----	3.4	3.96	22.16	7.05	29.21	.336	.173	.041	-----
ALL 1957 HONEY (313 SAMPLES)																			
Average....	5	3	17.3	11	38.36	31.37	1.31	7.22	1.38	-----	2.9	3.88	21.95	7.15	29.10	.334	.166	.041	-----

¹ See p. 6 for explanation of color and granulation codes.² Average for 263 samples.

TABLE 28.—Average composition of honey and honeydew samples classified by State of origin

State	Number	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
				Percent	Month	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg	Meq./kg	Meq./kg		Percent	Percent
Maine.....	1	7	5	18.8	27	35.70	33.90	1.98	5.88	2.32	1.4	4.10	24.11	4.82	28.93	0.200	0.180	0.067
New Hampshire.....	2	7	3	16.1	10	39.26	32.17	1.74	6.91	2.27	2.5	4.14	22.60	5.51	28.12	.228	.210	.047
Vermont.....	3	2	4	15.6	10	38.24	32.37	1.61	7.72	2.59	2.0	3.92	13.67	5.28	18.95	.387	.041	.029
Massachusetts.....	7	7	3	17.2	14	36.72	31.68	1.57	7.18	1.80	3.8	4.12	19.15	5.41	24.56	.291	.203	.043
Rhode Island.....	15	7	2	16.6	15	36.34	29.47	.88	9.51	1.76	5.4	4.14	22.25	6.96	29.22	.306	.343	.045
Connecticut.....	4	9	1	17.3	3	35.27	27.86	1.07	7.83	4.70	5.9	4.16	32.96	8.51	41.47	.269	.480	.045
New York.....	17	5	2	17.5	9	38.57	31.80	1.29	6.94	1.45	2.5	3.85	22.15	6.54	27.73	.312	.133	.046
New Jersey.....	8	8	1	17.4	11	37.87	28.81	.85	8.63	2.04	4.3	4.13	28.79	7.63	36.41	.278	.287	.055
Pennsylvania.....	27	7	2	17.7	10	36.22	30.59	.94	7.44	2.01	5.1	3.98	27.84	6.33	34.17	.243	.252	.053
North Atlantic.....	84	6	2	17.3	12	37.05	30.65	1.10	7.67	1.99	4.2	4.01	24.60	6.55	30.97	.280	.239	.049
Ohio.....	7	6	2	18.2	15	38.16	32.56	1.58	6.14	.98	2.2	3.77	21.79	8.38	30.31	.395	.082	.029
Indiana.....	8	6	2	17.5	13	38.83	30.75	1.30	7.02	1.39	3.1	3.73	28.52	9.64	38.18	.351	.162	.057
Illinois.....	9	4	2	18.2	13	38.06	32.49	1.49	6.13	.98	2.5	3.74	21.88	7.00	28.88	.311	.114	.042
Michigan.....	7	4	3	17.6	11	38.37	32.73	1.24	5.84	1.36	2.7	3.82	22.18	8.65	30.83	.394	.099	.041
Wisconsin.....	16	3	3	18.2	14	38.01	31.76	.97	6.84	1.34	2.8	3.86	18.51	6.37	24.88	.340	.099	.036
East North Central.....	47	4	3	18.0	13	38.23	31.97	1.25	6.50	1.23	2.7	3.79	21.82	7.64	29.48	.352	.110	.040
Minnesota.....	26	4	2	18.9	12	37.95	31.70	.99	6.54	1.24	2.6	3.83	18.72	5.88	24.60	.318	.093	.037
Iowa.....	17	3	2	18.7	9	38.94	32.59	1.06	5.86	.99	1.9	3.84	18.81	6.52	25.32	.350	.098	.038
Missouri.....	7	6	2	17.0	12	37.65	30.31	1.93	6.89	2.48	3.6	3.92	26.01	10.25	36.26	.411	.141	.062
South Dakota.....	4	1	5	16.6	8	38.72	33.57	2.23	5.97	.81	2.1	3.88	11.43	3.87	15.27	.337	.031	.022
Nebraska.....	7	3	4	16.9	13	38.37	33.22	1.38	6.23	.97	2.9	3.89	15.41	7.09	22.50	.463	.068	.032
Kansas.....	2	4	2	17.2	11	38.31	33.58	2.27	6.07	1.12	1.6	3.84	20.48	9.82	30.29	.474	.070	.042
West North Central.....	63	4	3	18.2	11	38.27	32.13	1.29	6.32	1.26	2.5	3.86	18.78	6.69	25.46	.360	.092	.039
Delaware.....	1	9	0	17.0	5	37.06	29.63	.87	8.68	1.30	5.5	4.28	26.44	6.25	32.69	.236	.275	.041
Maryland.....	16	8	1	17.1	15	36.68	27.15	.78	10.24	2.44	5.6	4.27	27.54	4.53	32.06	.201	.284	.048
Virginia.....	11	7	0	17.2	10	37.91	26.42	.80	10.27	2.44	4.9	4.20	24.07	4.27	28.34	.190	.303	.040
West Virginia.....	2	7	0	18.6	21	37.46	30.43	.87	7.00	1.92	3.1	3.79	28.76	10.88	39.61	.379	.152	.067
North Carolina.....	11	7	1	17.8	16	37.53	27.04	.98	10.40	2.18	4.0	3.99	21.57	6.78	28.35	.333	.201	.043
South Carolina.....	1	7	1	17.4	20	39.67	28.39	.97	9.52	1.21	2.8	4.01	27.44	8.14	35.58	.297	.159	.057
Georgia.....	7	5	1	17.2	10	39.90	29.67	.76	8.15	1.35	3.0	4.03	20.00	5.87	25.86	.277	.139	.033
Florida.....	37	6	2	18.2	9	39.19	29.35	1.03	7.86	1.25	3.1	3.91	22.78	8.73	31.52	.388	.191	.039
South Atlantic.....	86	7	1	17.7	12	38.24	28.25	.91	9.06	1.81	4.0	4.01	23.71	6.99	30.70	.312	.220	.042

Kentucky.....	5	6	3	17.3	18	37.96	30.61	1.05	8.58	1.21	3.3	4.07	20.77	4.38	25.15	.197	.289	.043
Tennessee.....	12	6	1	17.8	13	36.29	27.06	1.13	10.97	2.25	4.3	4.03	27.25	7.17	34.42	.268	.296	.048
Alabama.....	1	6	0	16.0	21	39.14	30.06	.70	8.49	1.19	4.4	4.30	16.29	3.17	19.46	.195	.196	.044
Mississippi.....	7	4	2	17.7	23	38.15	30.44	1.04	7.70	1.49	3.2	3.88	18.17	5.09	23.26	.267	.102	.037
Arkansas.....	7	6	2	18.5	10	38.02	30.89	1.08	7.20	1.37	2.8	3.81	25.17	9.31	34.47	.365	.158	.036
Louisiana.....	8	6	3	17.8	10	38.01	31.72	1.02	6.86	1.13	3.4	3.88	22.75	7.70	30.45	.340	.152	.043
Oklahoma.....	10	5	4	17.0	14	38.17	31.78	1.66	7.03	1.42	2.9	3.81	22.94	8.27	31.18	.370	.122	.044
Texas.....	18	5	4	17.2	10	37.92	33.21	1.07	6.13	1.01	3.1	3.85	27.66	10.20	37.85	.388	.204	.035
South Central.....	68	6	3	17.5	13	37.75	31.04	1.15	7.65	1.39	3.3	3.89	24.40	7.92	32.31	.326	.192	.041
Montana.....	25	2	6	16.1	10	39.48	33.39	2.31	6.12	1.07	1.6	3.89	12.50	5.11	17.77	.407	.057	.028
Idaho.....	4	3	6	15.0	10	39.91	34.03	1.57	6.50	.93	2.0	3.90	12.40	4.75	17.15	.389	.054	.024
Wyoming.....	13	2	4	16.1	11	39.15	33.50	2.55	6.18	.88	1.6	3.83	12.20	4.12	16.23	.335	.042	.022
Colorado.....	10	4	3	16.0	8	39.35	32.16	1.20	6.99	1.42	2.8	3.97	20.72	5.20	25.91	.276	.190	.050
Intermountain West.....	52	2	5	16.0	10	39.41	33.22	2.08	6.35	1.08	1.9	3.89	14.03	4.86	18.95	.363	.081	.031
Arizona.....	12	6	7	16.0	9	39.70	36.03	1.56	4.99	.46	1.2	4.07	24.10	6.80	30.91	.275	.294	.031
Utah.....	1	4	2	14.2	6	41.54	32.02	1.16	7.14	1.29	2.6	4.00	18.89	5.45	24.34	.289	.123	.015
Nevada.....	2	4	9	15.6	9	36.09	36.64	3.97	5.75	.89	1.2	4.30	10.11	3.04	13.15	.294	.132	.030
Washington.....	8	5	4	16.2	12	40.76	32.05	.89	6.99	.97	2.1	3.95	26.20	7.30	33.49	.295	.207	.041
Oregon.....	19	4	2	16.0	17	37.43	30.13	1.57	8.64	2.46	3.5	3.86	21.15	8.01	29.15	.403	.161	.045
California.....	60	5	5	16.3	15	38.46	32.20	1.57	6.82	1.45	3.1	3.82	24.33	9.35	33.68	.391	.171	.047
Alaska.....	2	5	1	15.5	24	39.19	30.27	.86	9.73	2.42	2.4	4.07	13.10	3.95	17.05	.299	.083	.033
West.....	104	5	4	16.1	14	38.61	32.33	1.55	6.99	1.48	2.8	3.88	23.26	8.31	31.57	.365	.184	.043

¹ See p. 6 for explanation of color and granulation codes.

TABLE 29.—Average composition of "single-source" honey and honeydew samples classified by plant family

Family	Number	Color ¹	Granulation ¹	Moisture	Age	Levulose	Dextrose	Sucrose	Maltose	Higher sugars	Undetermined	pH	Free acid	Lactone	Total acid	Lactone/free acid	Ash	Nitrogen
				Percent	Months	Percent	Percent	Percent	Percent	Percent	Percent		Meq./kg	Meq./kg	Meq./kg		Percent	Percent
Anacardiaceae	3	7	1	16.5	14	35.20	26.90	1.03	9.51	4.16	.7	4.49	24.47	5.77	30.24	0.263	0.499	0.053
Aquifoliaceae	8	6	1	17.3	14	39.63	29.02	.79	8.30	1.46	.3	4.24	17.29	4.46	21.74	.255	.173	.028
Asclepiadaceae	1	4	0	16.1	16	35.35	28.34	2.63	7.20	5.30	4.7	3.90	15.84	6.99	22.83	.441	.103	.040
Boraginaceae	1	2	1	16.4	17	37.30	31.27	1.28	8.43	2.53	2.4	3.88	11.81	4.69	16.50	.397	.039	.033
Clethraceae	1	8	4	17.8	12	36.30	31.30	.81	7.11	1.63	5.0	4.18	21.85	10.18	32.03	.465	.235	.053
Compositae	18	6	2	17.5	12	38.19	31.17	1.15	7.18	1.45	.3	3.88	24.98	7.48	32.46	.284	.202	.055
Cruciferae	2	8	1	18.8	17	37.14	29.34	.78	8.43	1.18	.4	3.93	25.84	6.41	32.25	.266	.191	.043
Cucurbitaceae	2	6	5	17.1	11	37.60	33.55	2.15	5.54	1.03	.3	3.81	26.20	9.81	36.05	.385	.149	.033
Cyrillaceae	2	8	2	17.6	20	40.04	28.87	.90	7.22	.92	.4	4.49	17.02	2.00	19.02	.118	.216	.023
Ericaceae	10	5	2	17.1	13	36.64	28.61	.82	10.36	2.21	.4	4.44	15.18	3.95	19.14	.260	.233	.031
Fagaceae	9	10	1	16.5	12	34.39	26.12	.86	11.14	3.15	.8	4.50	42.60	5.02	47.63	.131	.647	.099
Juglandaceae	1	10	1	15.3	9	31.10	23.89	1.02	8.96	7.78	.3	3.91	33.76	3.99	37.75	.118	.670	.046
Labiatae	12	5	3	17.0	12	39.00	31.90	.99	6.46	1.36	.3	3.80	19.13	8.89	34.88	.365	.231	.043
Leguminosae	108	4	3	17.1	12	38.47	31.96	1.67	6.92	1.35	.2	3.80	21.09	7.76	28.86	.372	.125	.044
Lythraceae	3	5	2	18.3	12	37.75	29.90	.62	8.13	2.35	.3	3.80	21.09	7.76	28.86	.372	.125	.044
Magnoliaceae	4	10	0	17.6	13	34.65	25.85	.69	11.57	2.96	.7	4.45	38.28	4.71	42.99	.121	.460	.076
Malvaceae	11	5	8	16.1	10	39.41	36.53	1.16	4.97	.49	.1	4.22	25.07	6.25	31.33	.239	.331	.036
Myrtaceae	2	6	3	17.0	18	39.35	32.27	1.43	6.84	.80	.2	4.14	18.96	7.51	26.46	.383	.204	.050
Nyssaceae	6	7	0	18.2	18	43.27	25.95	1.21	7.97	1.11	.2	3.87	25.46	11.12	36.59	.435	.128	.046
Oleaceae	5	5	4	16.3	19	39.33	30.58	1.23	7.26	1.49	.3	3.76	25.51	11.19	36.70	.419	.127	.040
Palmae	4	6	1	18.3	8	37.94	31.14	.71	6.57	1.30	.4	3.89	25.51	10.01	36.04	.416	.238	.041
Pinaceae	3	10	2	14.5	14	25.16	25.92	.68	6.20	9.61	1.8	4.43	55.28	8.40	63.27	.143	1.001	.048
Polygonaceae	14	8	3	17.7	12	36.79	30.10	.92	7.17	1.71	.5	4.01	30.76	6.42	37.18	.214	.237	.059
Rhamnaceae	1	6	1	13.7	14	37.81	30.95	1.35	8.84	3.22	4.1	3.88	38.23	7.46	45.69	.195	.187	.059
Rosaceae	6	8	2	17.4	16	36.20	27.65	.65	9.85	2.64	.6	4.22	28.31	3.45	29.50	.145	.473	.070
Rubiaceae	1	9	0	18.2	6	38.28	29.42	.75	7.94	1.38	4.0	3.90	42.23	13.56	55.79	.321	.268	.067
Rutaceae	3	4	4	16.7	17	39.26	31.83	1.87	6.50	1.33	.2	3.67	24.23	13.12	37.35	.540	.082	.030
Salicaceae	2	7	4	17.9	10	40.80	32.51	.98	5.36	.48	.2	4.02	17.16	4.87	22.03	.280	.094	.028
Scrophulariaceae	1	4	2	17.1	8	39.35	32.21	.68	6.93	.98	2.7	3.98	17.54	7.23	24.78	.412	.063	.036
Tamaricaceae	1	7	9	14.3	12	40.84	39.11	.78	3.66	.13	1.2	4.09	29.05	8.84	37.89	.304	.240	.069
Tiliaceae	3	4	3	17.4	15	37.88	31.59	1.20	6.86	1.44	.3	4.05	16.78	6.58	23.70	.382	.084	.022
Verbenaceae	1	5	4	22.3	6	36.05	31.61	.45	5.18	.59	3.5	3.93	22.28	6.61	28.89	.298	.119	.017
Vitaceae	2	11	0	19.5	18	35.30	25.37	1.05	12.49	1.74	.4	3.97	29.91	8.50	38.40	.295	.194	.050

¹ See p. 6 for explanation of color and granulation codes.